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Edited by P. M. Hickey, M. D.
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THE AMERICAN JOURNAL OF ROENTGENOLOGY

Editor, P. M. Hickey, M. D., Detroit
Associate Editor, F. C. Zapffe, M. D., Chicago

VOL. II APRIL, 1915 No. 6

ROENTGEN EXAMINATION OF FOREIGN BODIES

By DR. G. W. GRIER, Pittsburgh, Pa.

The radiography of foreign bodies aspirated or swallowed has become such an every-day occurrence with the average roentgenologist that I approach this subject at the risk of becoming tedious from repetition of already well-known facts. The object of this paper is not to present anything new in the radiography of foreign bodies but rather to rehearse certain facts which if kept in mind when the examination is made will facilitate the accurate and speedy localization and removal of the foreign body. Unfortunately the very nature of most of these cases, the fact that they are emergency cases in which haste is necessary and that they usually occur in children or infants whom it is difficult or impossible to control, makes their radiography, particularly from an esthetic point of view, rather unsatisfactory.

Unless the respiratory symptoms of the patient absolutely indicate that the foreign body has been aspirated and not swallowed, we always make plates to cover from the naso-pharynx to the rectum. I believe this is the best policy to assume regardless of symptoms as there are cases on record in which multiple foreign bodies have been aspirated and swallowed at the same time.

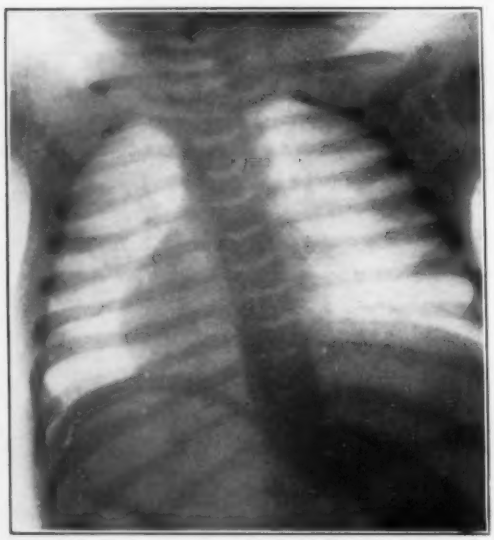
In regard to views we always make a direct antero-posterior and a direct lateral view of each part. A lateral of the neck is indispensable in all foreign body cases. Case I. illustrates this point. Here the large nail in the naso-pharynx which shows so plainly in the lateral view is almost off the upper edge of the plate in the antero-posterior view although the plate is placed high enough to show considerable of the lower jaw. Likewise small foreign bodies or bodies not very opaque such as chicken bones or small slivers of bone in chops will show in the lateral view of the neck and not in the antero-posterior view.

Lateral views of the chest will also often show foreign bodies in the esophagus or in the lung behind the heart which are not visible in the anterior view. This is illustrated in Case II. in which a woman 46 years of age had swallowed a pearl collar button 26 years before. When seen she had an immense pyopneumothorax which was drained after which the radiographs, Figs. 3 and 4, were taken. The button could not be seen in the antero-posterior plate (Fig. 3) but was plainly visible in the lateral (Fig. 4). This plate was made in what is known as the quartering lateral position, which we no longer use, preferring the direct lateral as being less confusing.

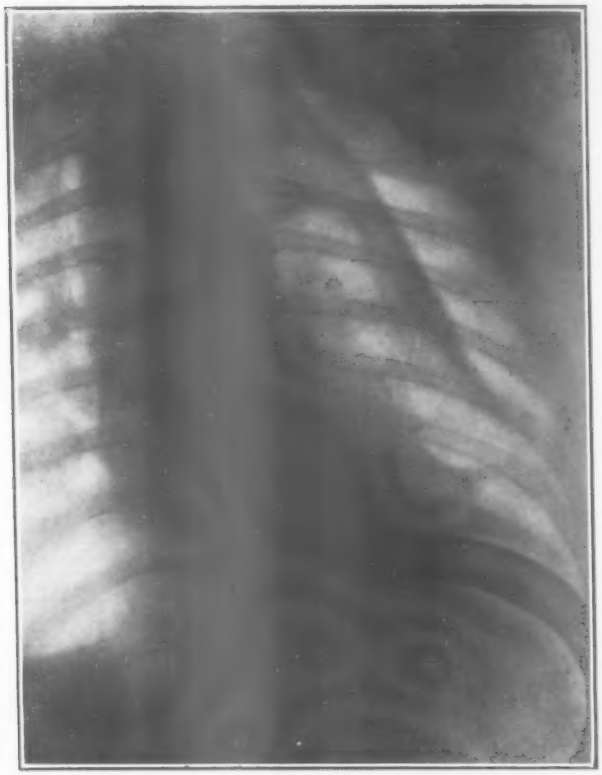
The character of the foreign body is but little indication of the location in which it may be found. Thus the ordinary campaign button with a stiff pin projecting from the side would appear to be an almost impossible object to swallow and as a matter of fact usually does lodge in the esophagus at the episternal notch as shown in Case III. Fig.

5. However that it may go safely and uneventfully through the alimentary canal to the rectum is shown in Case IV. Fig. 6. This case was seen by us shortly after the pin was swallowed and radiographs were made at frequent intervals until the pin reached the rectum, which it did at the end of 99 hours and was passed at 105 hours. On the second day after this pin was swallowed the question arose as to whether it was still in the stomach as it occupied a position in the left hypochondrium in the stomach area, and the surgeon insisted on doing a gastrotomy for its removal. Having been placed in an embarrassing position through misinterpretation of location in a similar case, the circumstances of which we will relate, we gave this child a small quantity of bismuth and water to swallow and made plates in anterior and lateral positions and showed the pin to be outside the stomach.

The difficulty, however, in telling whether a foreign body is in the stomach or in the small bowel close to the stomach is greater than would be imagined. Case V. was a baby 8 months old, said to have swallowed an open safety pin 2 days before. Radiographs were made in antero-posterior (Fig. 7) and lateral positions (Fig. 8). The stomach is apparently quite visible in both plates, being distended with gas as most babies' stomachs are, and the shadow of the pin over-lying the gas in both directions. This gas shadow is evidently not the stomach, however, as subsequent developments showed and a bismuth meal should have been given to locate the pin in relation to the stomach. Following our advice the stomach was searched by gastroscopy by Dr. Chevalier Jackson, the author directing the gastroscopy by fluoroscopy. We fluoroscoped in the antero-posterior position only, at that time not having apparatus to fluoroscope in both planes simultaneously (since then we have designed apparatus for bronchoscopic or gastroscopic fluoroscopy in both planes and will describe this apparatus in a later communication). Under the fluoroscope, although the end of the gastroscope overlaid the pin repeatedly, Dr. Jackson was unable to see it and finally was compelled to abandon the operation. Subsequent laparotomy disclosed the pin embedded in the walls of the jejunum and posterior to the stomach. The manner in which it was embedded showed beyond doubt that it must have been there at the

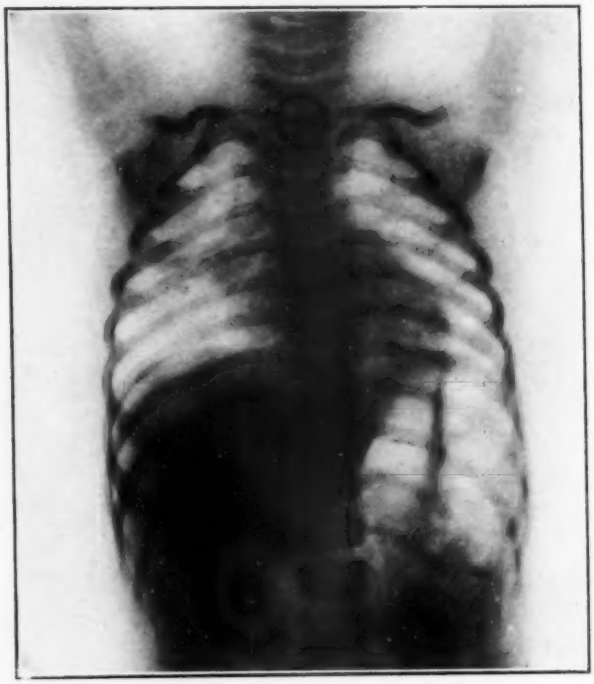


Case 1. Figs. 1 and 2. Wire nail in the pharynx. Shows beautifully in lateral view (Fig. 2) but might be missed in antero-posterior (Fig. 1) as the shadow is almost off the upper edge of plate. Emphasizes the necessity of placing plates high enough to cover the naso-pharynx.



CASE 2. Fig. 3. Radiograph after external drainage of pneumothorax, in a woman of 46 years. Foreign body—glass collar button—present did not show. The dark line from the first rib downward and outward towards the drainage tube is the thickened visceral pleura seen on edge. The lung is collapsed as far as pleural adhesions will permit.

CASE 2. Fig. 4. Quartering lateral radiograph showing collar button in the lung between the heart and the spine. Collar button had been present 26 years; and was removed by bronchoscopy through the mouth without anesthesia, general or local. (One year later patient weighed 182 pounds and was in perfect health.)

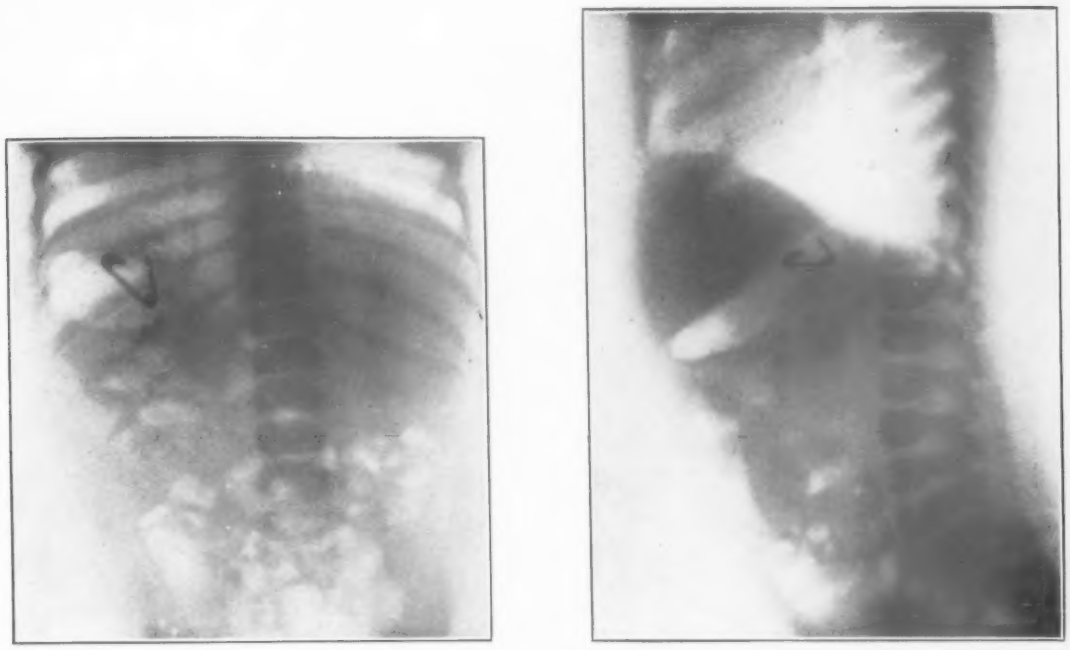


CASE 3. Fig. 5. Button with projecting rigid pin in the esophagus of an infant 2½ years of age. Removed by esophagoscopy without anesthesia.

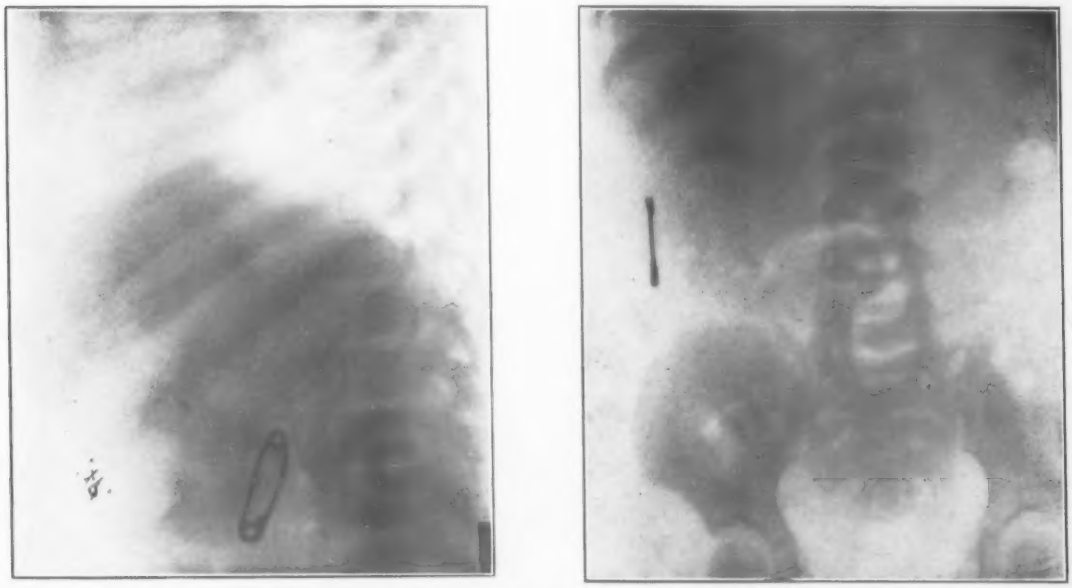
time of the gastroscopy. In all such cases where there is doubt as to whether the foreign body is in the stomach, we now give the patient a small liquid bismuth meal and examine (fluoroscopically or radiographically) in both planes. Case VI. Figs. 9 and 10 show a safety pin in the descending colon. The stomach is well outlined with gas in both plates, the shape and location marking it unquestionably as stomach. The pin in this case is not in the stomach area and naturally no question of its being in the stomach arose at all. If it had been in the stomach, operative measures would have been contra-indicated as closed pins of this character invariably pass spontaneously. The cases calling urgently for endoscopy are those in which the foreign body, even though smooth, has lodged in the esophagus or the air passages.

In radiographing foreign bodies in the air passages the shortest possible exposures are indicated, especially in infants and children too young to be reasoned with. If necessary, quality should be sacrificed to speed and a thin negative with the patient quiet is better than a properly exposed one in which the patient has breathed or moved.

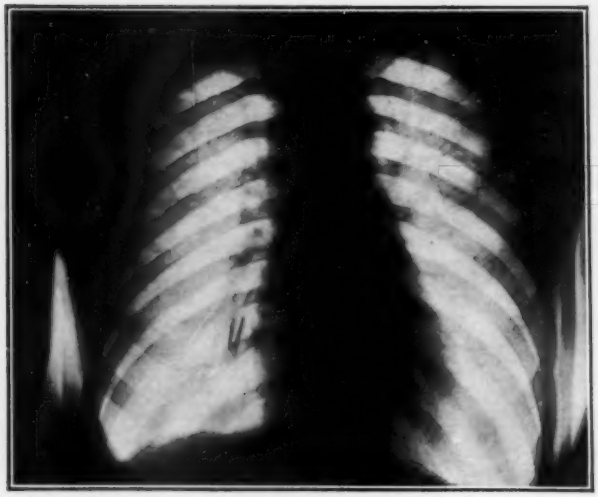
CASE 4. Fig. 6. Campaign button in rectum. Shows possibility of sharp pointed bodies passing harmlessly through the entire alimentary tract. The danger arises when they lodge.



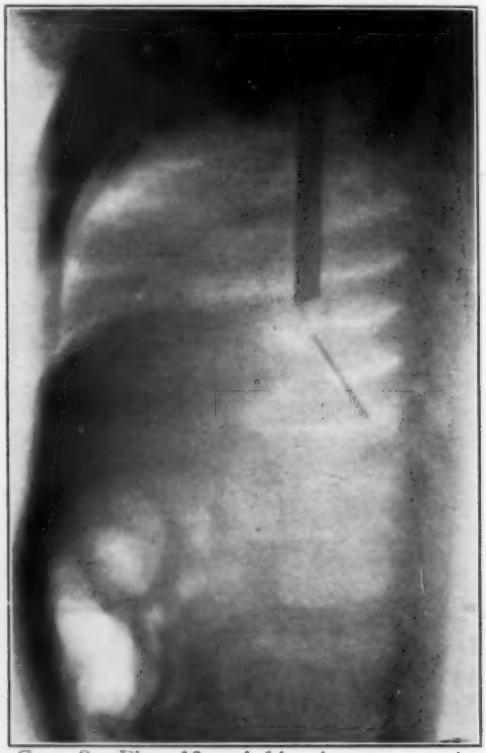
CASE 5. Figs. 7 and 8. Antero-posterior (Fig. 7) and lateral (Fig. 8) views of an open safety pin in the jejunum. It was thought to be in the stomach but being unable to locate it by gastroscopy, laparotomy was done and it was found imbedded in the wall of the jejunum.

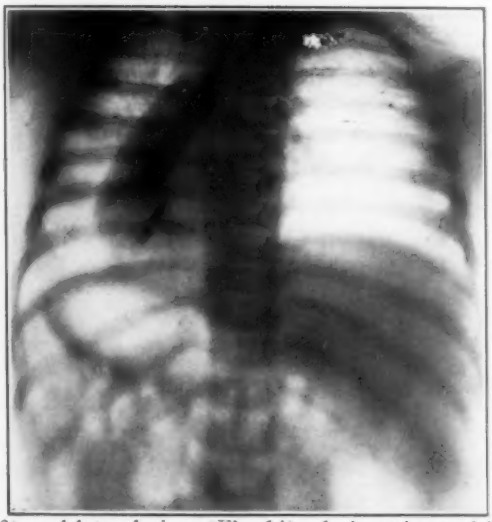


CASE 6. Figs. 9 and 10. Radiographs showing a safety pin in the left hypochondrium, below, to the left of and posterior to stomach. Located in descending colon. "St."—stomach outlined by gas.

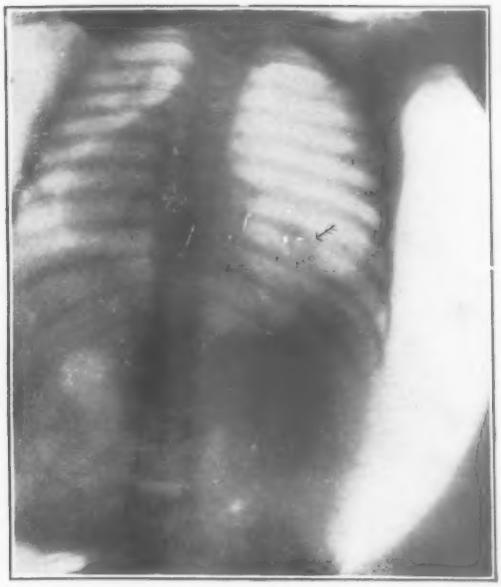


CASE 7. Figs. 11 and 12. Radiographs showing a fence staple in a posterior branch of a posterior branch of the inferior-lobe bronchus four inches below the bifurcation of the trachea. The localization, owing to the plain showing of the trachea and bronchi in the lateral radiograph, was of greatest assistance to the bronchoscopist. Removed through the mouth by bronchoscopy under local anesthesia.





CASE 8. Figs. 13 and 14. Antero-posterior (Fig. 13) and lateral view (Fig. 14) of pin at base of left lung with bronchoscope introduced as close as possible to the pin.



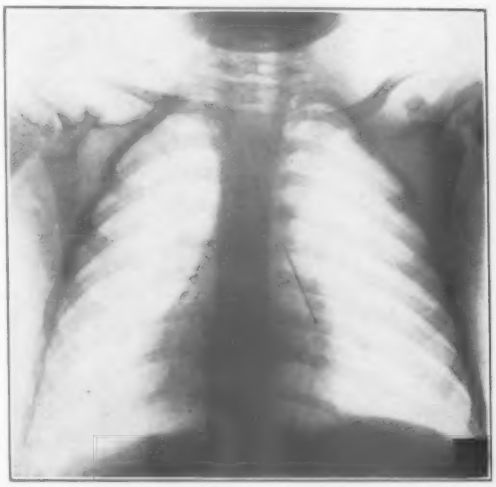
Case 9. Fig. 15. Radiograph showing abscess in right lung of a child 23 months of age, due to a peanut kernel which itself does not show; illustrating the fact that lesions may be discovered radiographically in cases of foreign bodies which themselves are not dense enough to be seen.

The short exposure will give details of the bronchi which are a great aid to the bronchoscopist in his determination of the location of the foreign body. If the patient breathes during the exposure the terminal bronchi will be blotted out even though the shadow of the foreign body shows plainly. Illustrated in Case VII, Figs. 11 and 12, in which Dr. Jackson was able from a knowledge of the distribution of the bronchi around the foreign body to turn the points of the staple into adjacent bronchi and bring the staple out breech first, the only possible way in which it could be removed.

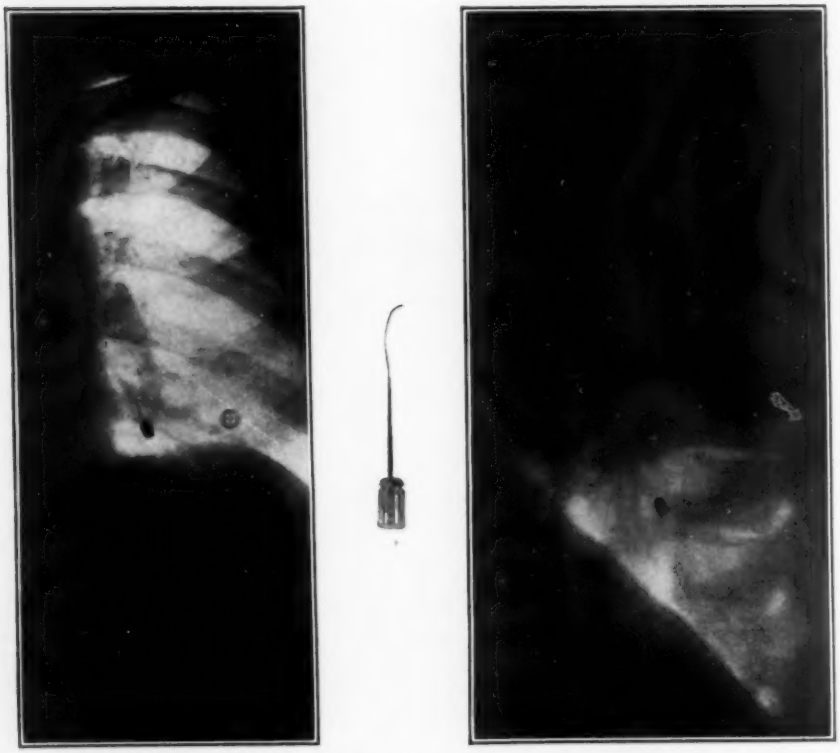
Because of lack of control over the majority of foreign body cases we have not found stereoscopy to be of much value but prefer two views made at right angles to each other (anterior and lateral), with the shortest possible exposure. The lateral view is especially valuable as the inclination of the foreign body forward or backward often indicates the particular bronchi in which it is located.

In cases in which the foreign body cannot be found by the bronchoscopist, radiographs with the bronchoscope in position may be very helpful. See Figs. 13 and 14, Case VIII. We never refuse to radiograph the case in which the foreign body is thought to be or known to be transparent to the X-ray for two reasons. First: the foreign body may be of a different character than supposed. Second: secondary changes in the lung due to the presence of the foreign body may indicate its location. We have located several peanuts in the lung in this manner. The abscess of the lung shown in Case IX, Fig. 15, with the fan shaped area of consolidation spreading out from it due to the plugging of the bronchus, are characteristic changes in these cases.

It is desirable that the Roentgen examination which is made for localization shall be made as nearly as possible to the time set for the operation for its removal. We have repeatedly seen foreign bodies change their location during the interim between Roentgen examination and operation. Case X, Fig. 16, shows a pin in the right bronchus of a little boy, having been swallowed two days before Bronochoscopy was performed by Dr. Chevalier Jackson on the day follow-



Case 10. Fig. 16. Pin in right bronchus which was coughed up in the interval between Roentgen examination and operation. The pin has a blunt point which made the coughing up possible.



CASE 11. Fig. 17. Radiograph showing a dental instrument (broach-reamer) in a small posterior branch of a larger posterior branch of the inferior-lobe bronchus of a man, aged 39 years. Removed through the mouth by bronchoscopy under local anesthesia. The extremely low position of the foreign body in the thorax is very unusual, and its bronchoscopic removal from this location is of especial interest.

ing the X-ray examination and as he could not locate the pin we made subsequent radiographs immediately following the operation (in fact upon the operating table) and no foreign body could be found in any part of the child's anatomy. It seems impossible of belief that such a foreign body as this could be coughed up and expectorated and still escape attention, yet such is unquestionably the case, as the child's bowels did not move in the interval between the two examinations, and the pin was not in the alimentary tract (nor chest) at the time of the second examination. The explanation is that during the night the child was seized with a violent fit of coughing so severe that he vomited and at this time must have thrown out the pin. The vomitus was not examined and the pin was never found.

In order to present to Roentgenologists the viewpoint of the bronchoscopist toward radiography of foreign body cases, I have obtained permission from Dr. Chevalier Jackson to quote from the proof sheets of "Peroral Endoscopy and Laryngeal Surgery," as follows:

1. "From the point of view of a bronchoscopist, a radiograph should be taken in every case of suspected foreign body, regardless of whether the foreign body is dense to the ray or not, because:

"(a) A foreign body not itself dense enough to show may have produced lesions which will show plainly.

"(b) A foreign body of little density may happen to be so located that its shadow may not be overlaid by normal shadows and may possibly lie so as to expose its greatest plane to the rays and hence cast a shadow even if of relatively slight density.

"(c) The foreign body may not be the same as that of which a history is given.

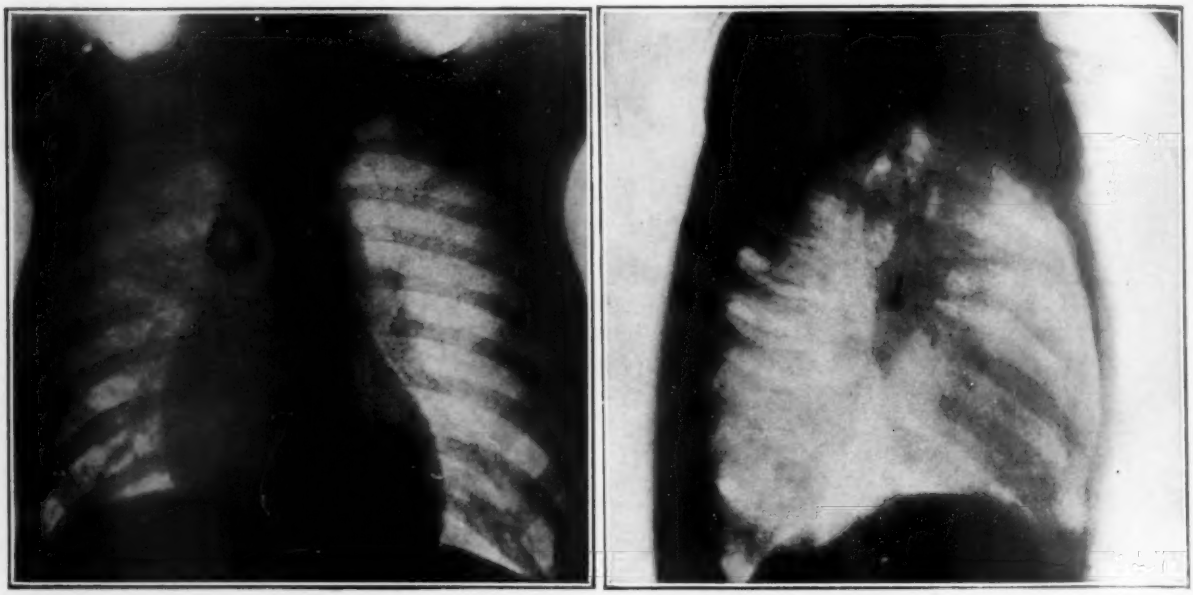
The most common example of this is the pin or other dense object which has gotten into the food and which, from the sensations and from its presence in soups, etc., the patient refers to as a 'bone.' In some such instances the supposed 'bone' has been found to be a pin from the cook's clothing, in other cases a chip of enamel from one of the cooking vessels, a bit of solder from a tin can, etc. Of 488 cases of foreign body recorded in the author's experience, the intruder or the sequential pathology has been visible roentgenologically in 362 (74 per cent).

2. "Foreign bodies of only very slight density in the oesophagus may sometimes be discovered by the stopping of a swallowed, bismuth-filled capsule. The capsule soon dissolves and the bismuth is a useful medication for esophageal trauma or inflammation. In some instances a foreign body showing so faintly as not to be findable could be seen after the location was fixed by the stopping of the capsule.

3. "As a rule it may be stated that foreign bodies more or less flat, whose plane corresponds to the lateral plane of the body, are in the esophagus and not in the air passages. In the larynx and upper trachea, flat bodies are almost invariably located with their greater plane sagitally.

4. "In the localization of foreign bodies with reference to the tracheobronchial tree, the author has had excellent results from the use of the positive films shown in Fig. 23. Like almost everything else in medicine and surgery these films cannot be expected to work out with absolute mathematical pre-

CASE 12. Fig. 18. Lateral radiograph of a safety-pin in a child of 11 months, demonstrating the esophageal location of the pin in this case and the great value of the lateral radiograph of foreign body cases. Pin passed into the stomach by esophagoscopic manipulation, turned and removed through the mouth without anesthesia, general or local.



CASE 13. Figs. 19 and 20. Brass-headed upholstery tack in the left bronchus of a boy, aged 8 years. Head of tack is in the orifice of the upper-lobe bronchus, the point being buried in the opposite main bronchial wall. Removed through the mouth by bronchoscopy without anesthesia, general or local.

cision; but by comparing their results in cases in which the foreign body was afterwards found and removed bronchoscopically, they have worked out with practical accuracy in 85 per cent of the cases. In the remaining 15 per cent the fault was in errors in the position of the overlay and in variations of type in the tree. With present experience the localization by means of the films is close to 90 per cent accurate.

5. "With the caliper shown in Fig. 24 a lateral radiograph taken with a marker on the chest wall anteriorly has been of great service in bringing the point of the bronchoscope at subsequent bronchoscopy into close relation with the foreign body. This is of use only where a foreign body is hidden 'around the corner' in the upper lobe bronchus or in a minute bronchus close to the periphery into which a bronchoscope cannot enter. It is not needed in any of the larger bronchi.

6. "In cases of a foreign body located far down and far out at the periphery where it cannot be followed with the bronchoscope, the author has had the greatest service from a radiograph taken with the bronchoscope in position, the bronchoscopist placing the tube-mouth at a certain location in the bronchi which can be subsequently found again. From a lateral and antero-posterior radiograph the distance and direction of the foreign body from the tube-mouth is determined, and with this guidance at a subsequent bronchoscopy the number of minute bronchi to be searched is diminished to two or three. The process is, of course, needless in the case of larger foreign bodies located in the bronchi above the third subdivision.

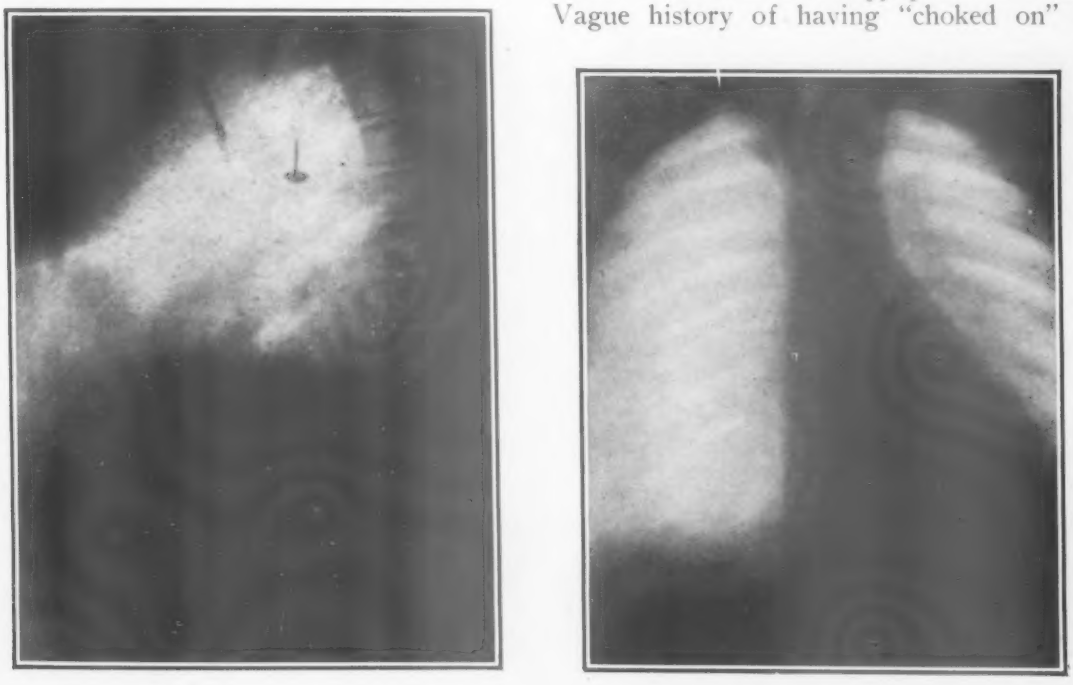
"FLUOROSCOPIC BRONCHOSCOPY. This procedure is not nearly so safe as bronchoscopy under guidance of the eye and is quite needless in any case in which the foreign body is located in a bronchus large enough for the bronchoscope to enter. With a good radiograph the bronchoscopist can go, in a few seconds of time, right to the location of the foreign body, the mechanical problem of safe removal can be studied out,

and the foreign body can be removed quickly and safely. But in case of a small foreign body located in the minute bronchus at the periphery of the lung, or 'around the corner' in the upper lobe bronchus, or when a foreign body has wandered outside, in all of which cases it is not findable by bronchoscopic search under direct vision, and the bronchoscopist can get invaluable assistance from collaboration with a fluoroscopist who tells the bronchoscopist whether the tube-mouth is too far to the right, left, front, back or intermediate direction. The author has had invaluable assistance of this kind from Dr. A. F. Holding and from Dr. George W. Grier. Dr. Grier's double-plane fluoroscope promises to be of great assistance in this particular class of cases. All roentgenologists recognize the great danger that would attend an attempt to grasp a foreign body with forceps under the sole guidance of the operator himself looking at the fluoroscent screen, not only because but a single plane is visible, but most important, the mechanical problem of disengaging and safely removing a foreign body can be solved only by examining the foreign body with reference to its relation to the bronchus in which it is located. Ruthlessly to grasp a foreign body and tear it out without regard to disengaging the point would be attended with an enormous percentage of mortality, while the mortality of ocularly-guided bronchoscopy and esophagoscopy is only a fraction over two per cent."

CASE REPORTS

CASE 1. C. M., infant aged 11 months. The parents gave a history of the child having swallowed some foreign body the day before. The nature of the foreign body was not known. Radiographs (Figs. 1 and 2) showed a wire nail in the pharynx which the surgeon removed with his fingers. Recovery perfect.

CASE 2. M. K., aged 46 years. Admitted almost dead with pyopneumothorax. Vague history of having "choked on" a



CASE 14. Figs. 21 and 22. Radiographs showing tack in left main bronchus of a child of 11 years. Removed by bronchoscopy through the mouth without anesthesia, general or local.

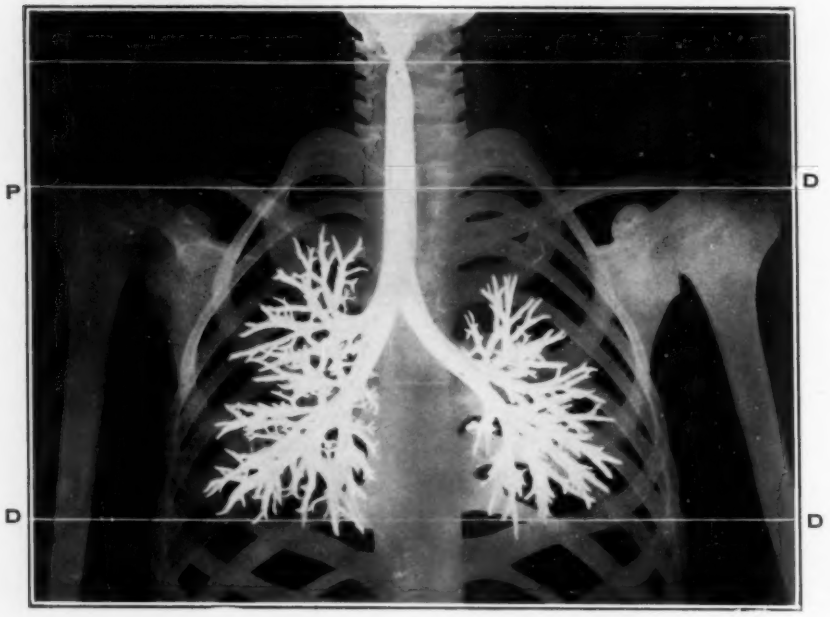


Fig. 23. Illustration of a positive film used for overlaying to assist in localization of foreign bodies or lesions in the thorax. The lower white line (D, D) corresponds to the diaphragm, the middle line (P, D) to the dome of the pleura. These lines assist in placing the overlay, the bony landmarks not being reliable because of variations in position relative to the viscera. The tracheobronchial tree necessarily is between the lines, D, D, and P, D. The few minute branches that go below the line, D, are those posterior to the apex of the dome. Twelve sizes of films are made.

pearl button 26 years previously. Pus evacuated by Dr. J. Hartley Anderson by rib resection. Anteroposterior radiograph (Fig. 3) showed the pus to have been evacuated but no sign of foreign body. A quartering lateral radiograph (Fig. 4) however, showed the collar button posterior to the heart shadow, the collar button not having followed the pus into the pleura. Collar button removed through the mouth by bronchoscopy without anesthesia, general or local. Perfect recovery. Weight of patient on admission, 98 lbs.; weight now, 3 years later, 182 lbs.

Case 3. M. H., aged 2½ years. Swallowed a campaign button with rigid pin three days previously (Fig. 5). Removed through the mouth by esophagoscopy without anesthesia, general or local. The button was rotated before removal to prevent trauma by the point of the pin. Recovery without any symptoms whatever.

Case 4. C. L., aged 6 years was brought in for Roentgen examination 5 hours after having swallowed a campaign button. Radiographs showed it to be in the stomach. It was decided to wait and see if the pin would pass spontaneously. Twenty-four hours later the pin was in the small bowel. At this time an argument arose as to whether the pin had actually left the stomach, which was settled by radiographing after a bismuth meal when the pin was found to be outside the shadow of the stomach. At the end of 52 hours the pin was in the ascending colon and at the end of 99 hours had reached the rectum. (Fig. 6.) It was passed without difficulty at the end of 105 hours.

Case 5. (Figs. 7 and 8). P. F., aged 8 months. History of having swallowed an open safety pin two days previously. Gastroscopy failed to find the pin in stomach. Pin removed by external operation, from the

jejunum, by Dr. F. H. Frederick. Recovery.

CASE 6. C. O., aged about 4 years, gave history of swallowing a safety pin on the previous day. Radiographs (Figs. 9 and 10) show a closed safety pin in the descending colon which was passed uneventfully the following day.

CASE 7. L. A. W., aged 44 years. Had "choked on" a wire fence staple 15 days before (Figs. 11 and 12). Removed through the mouth by oral bronchoscopy under local anesthesia. The staple was found tightly wedged in swollen mucosa in a posterior branch of the inferior-lobe bronchus. It was manipulated with hooks until the points were brought opposite a suitably spaced pair of branch bronchial orifices into which the points were guided by the lip of the bronchoscope while the forceps, grasping the curve, turned the foreign body over so that it could be withdrawn with the points trailing harmlessly behind. Patient made a perfect recovery without unfavorable symptoms.

CASE 8. C. C., aged 2 years. Swallowed a pin several days before. Radiographs taken at frequent intervals showed the pin to be working downward toward diaphragm, but several bronchoscopic examinations failed to locate the pin. Figs. 13 and 14 were made with the bronchoscope in position to determine its exact location, which was unfortunately in too small a bronchus to be entered for its removal. The pin was removed by surgical operation externally. Patient died.

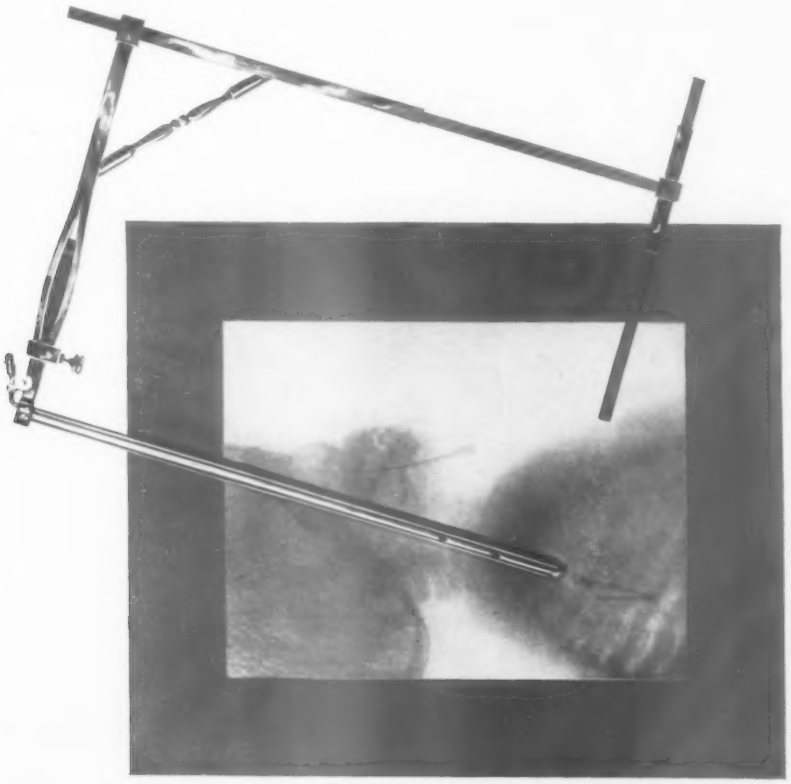


Fig. 24. Illustrating the position of the caliper guide in getting the adjustment by which the point of the bronchoscope can be brought, later at bronchoscopy, in close proximity to a foreign body. A marker is placed on the skin for use in case of very small foreign bodies in minute bronchi. Inadvertently, in making the illustration, a radiograph of an esophageally lodged foreign body (safety-pin) was used, but the principle is illustrated just as well.

CASE 9. F. L., aged 23 months. Suspected of having aspirated a peanut kernel six weeks previously. Parents told by one physician to "forget about it." Told by one roentgenologist, "No use taking a radiograph as a peanut kernel would not show." Radiograph (Fig. 15) showed abscess in right lung. Peanut kernel removed by oral bronchoscopy, thus evacuating abscess, including a slough of the bronchus. Peanut kernel was found at bronchoscopy to be in the inferior-lobe bronchus just below the orifice of the middle-lobe bronchus. Severe diffuse bronchitis endoscopically visible everywhere. Radiograph taken three weeks after evacuation of abscess showed the latter had cleared up. Patient died of bronchopneumonia six weeks later.

CASE 10. J. A. C., aged 5½ years. History of having "swallowed" a shawl pin two days before. Radiograph showed pin in right bronchus (Fig. 16). Oral bronchoscopy 24 hours later showed no pin and no sign of a pin having been present. Other radiographs made after bronchoscopy showed no sign of pin in neck, chest, stomach or intestines.

REMARKS: This is the only case ever recorded in which a pin lodged point up in a bronchus has been positively proven to have been coughed up. It was possible in this case only because the pin had lost its point. The point of a pin always embeds itself at each turn, preventing the possibility of the pin being coughed out. Objects not pointed have been known to be coughed up in a few instances, but in most cases of the coughing out of a foreign body it had not been definitely located in a bronchus and probably was in the larynx, pharynx or trachea. This case shows the advisability of having the radiograph made immediately before bronchoscopy. It was afterward learned that this patient had vomited after a severe coughing attack during the night, but the pin was never found.

CASE 11. E. A. S., aged 39 years. Aspirated a dental instrument (Broach reamer) 7 days previously. Radiograph showed the instrument point up, very low in the chest, almost down to a level of the dome of the diaphragm (Fig. 17). Removed through the mouth by bronchoscopy under local anesthesia. Bronchoscopy located the instrument in a small posterior branch given off from a main posterior branch of the inferior-lobe bronchus, the lowest position from which a foreign body has ever been removed bronchoscopically. Perfect recovery. No symptoms whatever. After bronchoscopy the patient sat on observation stand and watched the bronchoscopy on the next patient.

CASE 12. E. G., aged 21 months. Swallowed an open safety-pin of large size 12 hours previously. Radiograph (Fig. 18) showed pin, point up, in the thoracic esophagus. Removed by esophagoscopy without anesthesia, general or local. Pin was carried down to the stomach, turned and pulled into the mouth of the esophagoscope to close it and to prevent trauma in withdrawal. Perfect recovery. No subsequent symptoms.

CASE 13. G. S., aged 8 years. "Choked on" a brass-headed tack two weeks previously. Radiographs (Figs. 19 and 20) showed tack on left side a little below top of heart shadow. Bronchoscopy located the tack with head in upper-lobe bronchus and point buried in the opposite main bronchial wall. Point disengaged and tack removed through the mouth by bronchoscopy without anesthesia, general or local. Perfect recovery.

CASE 14. F. B., aged 11 years. Had aspirated a tack 4 days previously. Bronchoscopy (Figs. 21 and 22) revealed point of tack embedded in the wall of the bronchus, the head being jammed into the orifice of the upper-lobe bronchus. Removed through the mouth by oral bronchoscopy after disengaging the point from the bronchial wall. No anesthesia, general or local.

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HARD X-RAYS

By W. D. COOLIDGE

By the hardness of X-rays we refer to a quality and not to a quantity factor. In using the term we have in mind that quality which enables the rays to pass through matter. The physicist has shown that the X-Rays are like ordinary light, differing from it only in the vibration frequency or wave-length. The X-rays owe their power of penetrating objects opaque to ordinary light, to their high vibration frequency, and the greater this is the harder the rays are.

In determining the vibration frequency or hardness of the X-rays, there are two things only that count, the atomic weight of the target material and the velocity of the projectiles, the electrons, which bombard it.* Other things being equal, the higher the atomic weight of the target metal the better suited it is to the production of the most penetrating radiations. Uranium has the highest atomic weight of all of the elements (238) and would therefore be best suited to serve as a target for the production of very penetrating X-rays were it not for certain limitations, such as its relatively low melting point. The consideration of this and of other properties, such as heat conductivity and vapor pressure, has led to the general adoption of tungsten (with an atomic weight of 184) as a target material. This step taken, there is then only one factor at our disposal, namely, the velocity of the electrons constituting the cathode ray stream. The higher this velocity is the more penetrating will be the X-rays produced.

*There is really a third factor, namely, the nature of the collision between the electron and the target. The face of the target, even though highly polished, is, when compared with a particle the size of the electron, exceedingly rough and porous. As a result, some electrons collide in such a way that they are brought to rest much more suddenly than others of the same velocity, and the former therefore produce harder X-rays than the latter.

This factor has been omitted from the discussion for the reason that it does not influence our general conclusions and is, moreover, entirely outside of our control.

For the sake of simplicity, the writer is also not taking into account the characteristic rays emitted by the target material, and is referring only to the so-called independent radiations.

Now the velocity of the electrons is determined by the voltage impressed upon the tube, and increases with the square root of the latter. The point deserving special emphasis is this, that neither the type of tube, nor the tube design, nor the vacuum, nor the milliamperage flowing through the tube, has anything to do with the simple statement that, with a given target, the only thing which affects the penetration of the X-rays produced is the voltage which is actually impressed upon the tube, and the higher this is the higher the penetration is. Any definite value of voltage implies of necessity a corresponding X-ray penetration.

If our X-ray generators were only constant potential sources, like the static machine and the storage battery, the whole matter would really seem as simple as it is. We would then never need to ask the question as to whether one tube was or was not giving X-rays of the same penetration as another tube, provided the two were being operated at the same voltage, as the mechanism of X-ray production would make it so of necessity.

Unfortunately for perfect simplicity, most X-ray work is done on variable instead of on constant voltage. But the simple fact remains that at any instant of time the penetration of the X-rays is bound to be that corresponding to the voltage on the tube at that moment, and this regardless of the type of tube involved or of the condition of that tube. A curve showing the voltage on the tube at each instant of time would then tell us how the penetration changed from instant to instant. We are then, in general, dealing with a mixture of rays varying among themselves in hardness to correspond with the varying potentials impressed upon the tube.

A very fertile source of discordant results in the past is the fact that the penetration

of this mixture is measured by different devices, and that these devices indicate entirely different things. The parallel spark-gap, for example, indicates maximum voltage and therefore serves as a measure of penetration of the hardest rays in the mixture, while the Benoist and several of the other penetrometers indicate a sort of average value of penetration.

The Benoist and the parallel spark-gap readings really belong together only after we have filtered the rays so strongly that a picture of the Benoist penetrometer is made entirely with the hardest rays. For these are the rays that are produced by the maximum voltage, and it is this maximum voltage that causes the spark to jump across the gap.

By filtering we cut out the softer rays and so raise the average penetration of the remaining mixture. This does not mean, however, that we are increasing the hardness of the individual radiations. The word filtering denotes exactly what we are doing, for the filter merely lets the hardest radiations pass and stops the others. The operator then never needs to fear, nor can he profitably hope, that he is getting any rays of higher penetration than those corresponding to the voltage indicated by the parallel spark backed up by the tube. He can get harder rays in only one way and that is by raising voltage.

The above facts have been known for some time, and sources of very high potential have long been available; but there have been difficulties in connection with the production of a tube which could be continuously run on very high voltages.

The work which has been done in our laboratory has seemed to indicate that a tube of suitable design with a hot cathode and with a sufficiently high vacuum could be built to operate on any attainable voltage. The tube of this type which is now on the market can safely be used on voltages as high as that corresponding to a 10-inch spark between points.

We have recently made up some experimental tubes of this same type, but with certain modifications,* which can be run while backing up a 20-inch spark, and there is still every indication that tubes of this type can be built for very much higher voltages than this.

While we know that we can now produce X-rays having a penetration corresponding to the voltage indicated by a 20-inch spark between points, we have not yet actually measured the penetration in terms of air or aluminum. Such measurements are now in progress, however, and will, when completed, tell us without any assumptions how the hardness of these rays compares with that of the X-rays from radio-active substances.

There appears to be considerable reason to think that the X-rays produced by the voltage corresponding to a 20-inch spark gap will be found to have as high penetration as the hardest of the gamma rays from radium. For the 20-inch spark between points probably corresponds to something like 200,000 volts, and Rutherford, in the August number of the Philosophical Magazine, points out that, on the basis of the Quantum Theory, it is easy to show that 180,000 volts when applied to an X-ray tube should give radiations with a penetrating power equal to that of the hard gamma rays from radium C. These are the most penetrating of the radiations coming from radium in equilibrium with its decomposition products. They are only half absorbed in a thickness of 6 cm. of aluminum.

The field of usefulness for very penetrating radiations seems to the writer to be one of alluring possibilities, both from the radiographic and the therapeutic standpoints.

On the radiographic side such rays may prove to be too penetrating to be generally useful in medical diagnostic work. But it seems almost certain that they will find an important commercial application in the diagnosis of faults in metals and in other ma-

*The distance between terminals has been increased, and the cathode design is different in that the filament is set much further back in the focusing tube.

terials used in the arts. In some recent radiographs which Dr. Davey has made of steel castings flaws within the metal have been revealed with surprising sharpness.

In order that radiographic work on metals shall assume any considerable and general technical importance, it is absolutely necessary that very penetrating rays should be used, as otherwise the time of exposure for thick objects becomes prohibitive. The helpful effect in this direction of high penetration is readily seen from the following data: According to Kaye, an X-ray beam of average hardness has a linear absorption coefficient in aluminum of about 10, and Rutherford finds that the most penetrating gamma rays from radium have an absorption coefficient of 0.115. We can readily calculate from these data that the X-ray beam of average hardness to which Kaye refers will undergo so much absorption that less than 5/100,000 of it will get through a layer of aluminum 1 cm. thick, while with the same thickness of aluminum and the most penetrating rays from radium, 0.9 will get through. In other words, if the two beams of rays were of equal intensity on the incident side of the aluminum, they would be in the ratio of 1 to 20,000 on the emergent side.

In the field of Roentgen therapy, it seems equally desirable, at least for experimental work, to be able to produce rays having a wide range of penetrating powers running up to and, if possible, even exceeding that of the most penetrating gamma rays from radium. Moreover, it seems logical to do a lot of experimental work with essentially homogeneous rays. It would then be a simple matter to find out whether there is any specific action; that is, whether, for a certain purpose, rays of some one frequency are better than those of any other frequency. A simple method of getting essentially homogeneous rays is by filtering, and so long as the source is sufficiently powerful, there seems to be no objection to this method. Dosage measurements beneath different thicknesses of aluminum will show in any case just how thick a filter is needed to give essentially homogeneous rays. Unless some such procedure as this is followed, it seems to the writer that we fail to realize the main benefit that might come from the use of high voltage on the tube. If high voltage is used and, in conjunction with this, the same filter that has been used for lower voltages, the time needed to deliver a given dosage as measured by the Kienböck strip, for example, can be reduced. But, as the saving of time is not the main desideratum, it would certainly be interesting as an experiment to progressively increase the filter thickness as the voltage on the tube is increased, with the idea of getting not a reduction in time but rather a treatment with more penetrating rays. The author realizes that this is not a new idea. He merely wishes to call attention to the fact that technique such as that published by Krönig and Gauss for example, was not adopted from free choice, but partly, as they themselves say, because of apparatus limitations, and that it is possible to do things now with X-ray tubes that were physically impossible then.

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THE PROTECTION NECESSARY WHEN USING THE HARDER RAYS

By H. W. VAN ALLEN, M. D., Springfield, Mass.

With the adoption of new devices we must adjust our ideas to new resulting conditions. New dangers arise and we must place new restrictions upon ourselves. Often the serious thoughts concerning these restrictions first come when the dangers have made themselves manifest by their untoward effects.

A new field of opportunity has been opened to the Roentgenologist by the advent of tubes capable of producing gamma rays in quantities heretofore not obtainable. With the untold possibilities and advantages of this new condition comes new and possibly little realized dangers. However, to the experienced Roentgenologist the first impression he gets from the non-fluorescing hot cathode tube in action is its dangers. "Safety first" must be our slogan for success with tubes of this type. We have constantly in mind a list of martyrs to the Roentgen ray which, let it be hoped, will cease to grow in the future. Most of these men received their initial injury before the harmful effects of the rays were understood and now that we have additional Roentgen power at our hand let us be safe rather than sorry.

From a radiographic standpoint the protection which has been recognized as sufficient is still the same, but for deep therapy, using rays of high penetration, the ordinary X-ray protection is entirely inadequate. I might stop, however, to say that in many of the laboratories the protection is not up to the recognized requirement for radiographic work.

These conditions should be fulfilled in each case:—(a) The target should point away from the operator. (b) The tube should be more than six feet from the operator. (c) Lead 1/16 of an inch in thickness should be on three sides of the switch booth and ⅛ inch thick on the side directly between the tube and the operator. Between this lead and the operator must be some material capable of absorbing the secondary rays caused by the gamma rays striking against the lead. A good arrangement is to place the lead outside of the wood material of the booth. (d) The booth should be ventilated as the depressive effect of ionized air is very harmful. This is a simple recount of the recognized rules for protection in radiographic work.

I believe these are equally effective with all kinds of tubes regardless of their type, for in this class of work the milliampere seconds are not radically increased by the increased power at our command.

It is with the deep therapy that new protective precautions are needed.

The new method of cross-fire treatment increases the time per patient so materially, and as we will have in the near future tubes which give almost pure gamma rays in large quantities with little limit to the length of time such tubes can be kept active, it is evident our danger as operators will be greatly augmented.

Some authorities claim that there is not as much danger in the gamma ray as in the less penetrating ray. This is still an unproven theory and too many have already suffered by the effects produced before time has shown the end results to be so disastrous from so innocent an appearing cause. Here again we might remark, "Safety first."

Gamma rays are defined as ether vibrations of very short wave lengths. They are extremely penetrating and non-deviable by magnetic fields.

The view accepted by many students in regard to the action of the gamma ray in tissues is that it is not the gamma ray itself that acts on the cells, but secondary rays which appear in the tissues as a direct result

of the presence of the gamma rays. These rays are in every way similar to the beta rays.

The efficiency of tubes formerly in gamma rays was small and thin sheets of lead over the operator's booth were sufficient.

The length of time of application in toto of the gamma ray to deep seated lesions must be much longer than in treating superficial lesions with the beta ray, as the tissue to absorb a given amount of ray is much greater.

I believe in the new method of treatment. It is the secondary ray similar to the beta ray that is to be feared. When the gamma rays emerge from a metal surface there are set up emergency secondary rays. The energy with which the secondary rays emerge is not so great but that they may be practically stopped by a number of convenient substances, as a small fraction of an inch of paper, cloth or rubber. As to the material to be used for screening, lead where it can be used is most applicable, for while it produces more secondary rays than some other metals, the thickness does not have to be as much and the cost for a given amount of protection is far less.

Of all of the above elements of safety distance is of the greatest importance.

Let us now consider the more direct methods of protection from the ray. It may be possible to place a shield inside the tube itself. This will be ideal. A small amount of metal so placed partially around the anode, will confine a major part of the ray, leaving only the cone of active radiation desired for our work. Such a screen of tungsten would not only act as a screen, but by its attachment to the target would help in absorbing the heat evolved. When such a tube comes forward, let us welcome it as an extra safeguard to be added to those already in use. The other method of protection is that immediately surrounding the tube. The lead glass, bowl shaped affair is the one still used in this country. This is seldom seen in European countries and I believe their apparatus in this respect is better.

The first essential of tube protection is that it should be a non-conductor of electricity. It should be as resisting to the X-ray as possible. It should be as light weight as possible, for neither of the two latter requirements is glass ideal, several substances being more practical.

For use of the Coolidge type of tube it seems to me some material opaque to ordinary light is desirable. Many patients are not a little disturbed by the sight of the close proximity of the highly heated anode. The old idea of X-ray burn comes to their mind. As there is nothing we, as operators, can learn by inspecting the tube, let us look for a better substance than glass for the protection near the tube. I saw in Prof. Von Graff's clinic in Vienna this summer such a shield made of vulcanized rubber similar to the protective flexible cloth used so commonly in America.

Many refinements of technique can be added to such a tube covering as devices to cool the tube with forced air current. It should carry some means for holding the filters as these are better so placed than on the patient. This will avoid burns from a secondary ray. These tube coverings should be as small as possible to facilitate their use in depression as the neck, groin and perineum.

Roentgenologists adhering to such technique seem to be in little danger from the ray, but it is so easy to retrograde, especially with the tubes that do not fluoresce, that it behooves us as scientific workers to be strict with ourselves and those in our employ that there may be no more loss of life or disfigurement from a force that when properly applied has been one of the greatest additions to the medical science for the past century.

A NEW POSITION IN RADIOGRAPHING THE SHOULDER JOINT

By W. S. LAWRENCE, B. S., M. D., of Memphis, Tenn.

The accompanying plates are presented to illustrate, what I believe to be, a new position in radiographing the shoulder joint. By means of this position, we get two views of the shoulder, at right angles to one another; and this has always been the most accurate and convincing method of localization. Hitherto, we have relied upon stereoscopic plates for accuracy about the shoulder, but two plates, at right angles, offer certain advantages over stereoscopic plates. They are much more easily understood by the average medical man, and should there be a legal phase, they lend themselves more readily to demonstration in court.

In making the plate, at right angles to the ordinary antero-posterior plate, the patient stands, or sits, erect, with the arm, of the shoulder to be examined, lifted from the side, to as nearly a right angle as it may be, without undue inconvenience to the patient. If the arm can be extended to only forty-five degrees, or even somewhat less, it is quite sufficient. The tube, with cylinder attached and pointing upward, is placed beneath the axilla—the patient leaning considerably towards the injured side, and grasping some part of the tube-stand with the hand. This leaning towards the side will bring the glenoid cavity, the acromion, and coracoid processes, well within the field. The full length of the coracoid is beautifully projected on plate. An assistant holds the plate on top of the shoulder, in a plane nearly parallel to a cross-section of the cylinder. The assistant should grasp the patient firmly, so that

No. 1

No. II

No. III

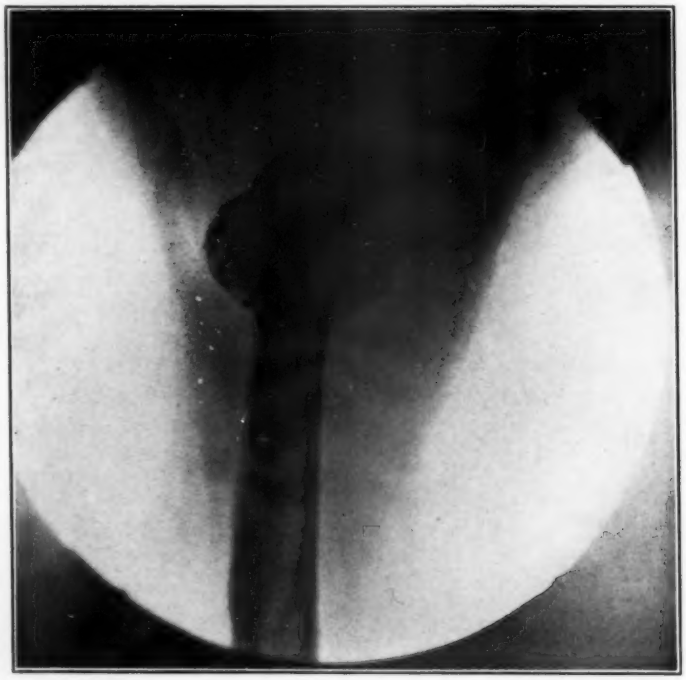
if either move, the other will also, and neither should breathe during the exposure. Any slight movement of the patient, will, however, matter little, for if properly arranged, plate, patient, and tube, will move together.

Plate No. I, is the ordinary antero-posterior view of a gun-shot shoulder.

Plate No. II, made with the ray entering the axilla, read in connection with plate No. I, shows the exact location of the bullet, in the head of the humerus.

Plate No. III, is the antero-posterior view of an injured shoulder, and besides some dislocation of the head downward, shows a fracture of the neck. From this plate, the fracture may be impacted, or the shaft may be in front of the head.

Plate No. IV, made with ray coming from below, when read in connection with plate No. III, shows this to be a true impacted fracture, and also, that the shaft is driven nearly straight into the head.



No. IV

RADIUM AND MESOTHORIUM IN CONJUNCTION WITH ROENTGEN THERAPY

By RUSSELL H. BOGGS, M. D., Pittsburgh, Pa.

All Roentgenologists realize the value of radium, but there is much difference of opinion in regard to its exact uses and limitations. Some will say they are unable to see any difference between radium and Roentgen ray reaction, while others will say that there are certain things that can be done with radium that cannot be done or at least duplicated, with Roentgen ray. Nearly all agree that certain lesions can be treated just as well with one agent as with the other. There is no question among the physicists that radium and the Roentgen rays have certain differences, but that each contains certain rays which are analogous.

Wickham and Degrais state that, "if a current of electric sparks be passed into and splits up in a glass vacuum tube (Crook's tube), it is filled with special fluorescence, and that certain rays, such as the anode, cathode and X-ray, are produced respectively analogous, but not identical with the alpha, beta and gamma rays of radium." It is not my purpose to attempt to describe the physical properties of radium, mesothorium or the X-ray, because my paper pertains to the clinical side of the subject.

It is generally admitted that the action of radium and mesothorium are the same. Most authorities who have worked with both claim they have observed practically no difference in the results accomplished. They all agree that the radio-active substances should be as highly concentrated and used in as small containers as possible as the penetration is deeper.

From a clinical standpoint, I believe the penetration, method of filtration and accessibility of application, more than the agent employed, determine the results in nearly all diseases which have been treated by the Roentgen rays and radium. Of course, radium or mesothorium are supposed to have about ten times greater penetration than the present Coolidge tube. There are only a few lesions where such high penetration is needed or used; because, even when treating with radium, most lesions are so situated that authorities advise using filters, which allow lower rays to pass, which predominates, and then the reaction is produced by this radiation.

Harnaman-Johnson in the British Medical Journal of May 9, 1914, in speaking of the X-ray and radium considers the terms convenient but arbitrary, and is of the opinion that they are each ether impulses, being identical except in power of penetration.

In reviewing the literature of the reaction produced on tissue by contact with radium, it is certainly very similar to that produced by the X-ray, which is well known to us all. It is more nearly identical than the physical description of radium or the Roentgen rays. When either is applied no organ is unaffected, provided the intensity be sufficiently great and the exposure sufficiently long. This does not mean that the intensity must be strong or even a visible reaction produced.

In this connection, allow me to quote several paragraphs from Finzi: "In general radium rays, in small doses, have a stimulating, and, in large doses, a destructive action. The dose required to destroy every type of cells varies greatly, for instance, gland cells may be destroyed by the small doses, which do not harm the cells of the connective tissue or the skin. In other words, the sensitiveness to the action of the rays varies with the type of the cells and this is what we mean by selective action of the rays. * * * The lymphatic organs are very sensitive to the rays, the action being characterized by a destruction of the lymphoid cells. This be-

havior is also shown in the spleen and bone-marrow, but in the latter with the destruction of the leucocytic cells there occurs an increase of the erythrocytic series. Muscle tissue degenerates under the action of the rays. Cartilage is very little influenced and even the large doses show increased growth. Endothelium of blood vessels is extremely sensitive to the rays, and with small doses swells up enormously and may completely obliterate the lumen of the vessel, while large doses cause its destruction."

So from Finzi's conclusions, it is clear that you would only have to refer to the physiological action of the Roentgen rays, which has been described by almost every member of this society, to see that the X-ray produced almost identical reaction. From the results produced by radium on angiomas and conditions closely allied to these tumors, such as flat naevi or port wine stains, it would appear that the endothelium of the blood vessels is more sensitive to radium than the Roentgen ray. Although Pusey states that he can even duplicate the results of those which even obtained in the treatment of vascular naevi by the Roentgen rays.

An advantage of radium frequently mentioned is that a dermatitis of the same degree heals up much more quickly, when produced by radium than by the Roentgen rays. In one or two cases in which I applied mesothorium, a dermatitis with a marked vesiculation occurred, and I was greatly surprised how promptly each healed without leaving a scar. I was rather inclined to think that it might be due to the small area involved, instead of the different quality of radiation. This is a point I can not decide at the present time, for you all know that we have produced dermatitis of a marked degree with the X-ray, and were surprised at how promptly it healed. It has been pointed out that when the gamma rays (filtered through two millimeters of platinum) produced a marked reaction, less fibrous tissue seems to be subsequently formed, than when a reaction of the same degree is produced by rays filtered through one-half millimeter of platinum. I believe for the last few years the most of us have been treating keloids with as high a penetrating X-ray as possible, because results can be produced quicker with less amount of radiation. Then would this indicate that the high penetrating rays have a more marked effect on fibrous tissue than the low penetrating rays?

Newcomet mentions "the absorption of fibrous tissue is one of the most marked features of the radio-active elements," but he does not state what quality of ray is the most effective.

The therapeutic value of radium cannot be rightly appreciated if it has not been studied with a sufficiently complete and varied range of filtration. It is very necessary to study secondary radiation produced by the various filters and the best methods of avoiding the deleterious effects of these rays.

In treating a case either by radium, mesothorium or the X-ray we always face a series of problems. Given a case with a certain lesion, its position, its extent, its susceptibility to the influence to this or that radiation, and then we must determine the agent or agents to use. The duration and method of application can be varied almost to infinity. This enables us to realize how rich radio-therapy should be in its results when properly selected and employed.

There have been so many ridiculous statements made by men of high standing about radium, for and against it, that the general medical profession has no clear conception of its real value. Some radium advocates have been greatly elated over the apparent cure of possibly fifty or even a hundred cases of epithelioma. They do not seem to know that five or ten years ago there were Roentgenologists who had produced similar results with the X-Ray. In fact we were all proud of our art galleries of photographs before and after treatment, but at present the cure of an epithelioma is almost as common as a Colles fracture.

In 1907 Pusey reported, at the Sixth International Dermatological Society, 111 un-

selected cases which had been treated more than three years before, and whose histories up to the time of the meeting were known. He showed a large number of photographs of epitheliomas before and after treatment. The following are Pusey's exact words: "Counting the thirty-one cases which were not radically cured as failures, there remain eighty successful ones in a list of 111 successive cases of epithelioma treated more than three years ago, showing 72% of successful results." These results are even better than those reported by Pinch of the Radium Institute, London, during the year 1913, in which he reported 111 cases of rodent ulcer, 40 cases apparently cured, 34 improved, 21 results not yet noted, 2 prophylactic treatment only, 4 examined but not treated and 7 not improved.

The comparison in the results in the treatment of many other superficial lesions where radium has been used, would be similar. It means nothing when some enthusiastic advocate of either radium or the X-ray states that there is no doubt that one agent has destroyed cancer whereas the other completely failed. Most likely the one applying the agent failed to recognize the limitations of his therapeutic agent. No one should expect to obtain the same results in cavities with X-ray alone as with radium or mesothorium, either alone or in conjunction with the X-ray.

I have seen cases made worse by destructive doses of radium, which probably would have been avoided if the after treatment had been just as radical as the first. Many advanced cases often warrant massive radiation but the after treatment must be carefully carried out. Here is a case to illustrate:

Mr. C., was referred after having consulted three of the best surgeons in the country. He had an epithelioma situated back of the ear about the size of a half dollar, with some glandular involvement. He had been told by the surgeons, whom he had seen that on account of his age (but in reality on account of the advanced condition of the disease) they would advise either X-ray or radium. Before he returned home he was given a massive dose of radium over the lesion. In three weeks there was a violent reaction which later became necrotic. I gave him X-ray treatment over the adjacent metastatic glands, covering the lesion with tin foil, which reduced them rapidly. As soon as the lesion became necrotic I strongly advised the removal of the necrotic area as the man was still in excellent health. But the surgeon objected to any such procedure, and said that the radium had only made it worse, and that, as the X-ray had some effect on the glands, wanted the original lesion treated with X-ray. This I did not do as it would only have been like giving more radium. If the necrotic area and the unhealthy surrounding tissue had been removed and a flap turned in, the man's life should have been made comfortable at least.

In consultation, I saw two similar cases in which X-ray treatment had produced the same result, one, in which the necrotic and degenerative area was removed and a flap turned in, and the other frozen with carbon dioxide. Both are apparently well at the present time. We must be able to differentiate between an epithelioma and degenerated X-ray tissue. I have frequently been alled in consultation to see why the X-ray was not effective in the treatment when perhaps the physician was treating degenerated X-ray tissue, while the removal of all this tissue and the turning in of a flap often effected a cure. Experienced Roentgenologists today are not producing such conditions but are seeing the condition after it is produced.

Hearing Charles Allen Porter's talk before the American Roentgen Ray Society in New York made me realize that, often the failure of an epithelioma to heal up was due to treating X-ray degeneration instead of an epithelioma. This fact has been very valuable to me in advanced cases of epithelioma. What has been said in regard to X-ray degeneration, I am sure, from what I have seen will apply to radium. However, I do

not believe we will have so much radium degeneration as there are not many radium or mesothorium tubes scattered around as there are X-ray machines.

All types of epithelioma of the skin, I believe, can be treated just as well with the X-ray as radium. Certainly superficial epithelioma is in most instances promptly relieved by both forms of radiation. Those who have had the most experience with radium think most of it and the same holds true of the X-ray. It is only necessary for the operator to be familiar with his agent.

But where the epithelioma is situated on mucous membranes in cavities, the same does not hold true on account of the inaccessibility of the X-ray and the ease with which the radium can be applied. Pinch states that "epithelioma of the bucal, lingual and pharyngeal mucous membranes still prove both refractory and disappointing in their response to radium, but a new method of treatment has recently been devised, which in instances of cancer of the tongue has given distinctly encouraging results; it consists in the burying within the carcinomatous nodule of a very small but intensely powerful radium tube. "A fairly severe reaction follows," he says, "and in some cases the nodules cease to grow and become replaced by dense fibrous tissue."

I have seen Abbe carry out this method but I do not believe we can expect much from it. An advanced case of cancer of the tongue is not a local disease, and what we need is a homogenous ray to check and obliterate the disease in the glands. In the advanced cases I have been able to check the progress and make the patient comfortable but have only one case which has been apparently cured for any length of time. On account of his remaining apparently cured I question the diagnosis. However, I believe he has not taken any treatment of any kind for over three years. If epithelioma of the tongue is seen early when the diagnosis is hard to make, there is a number of methods which will effect a cure, particularly so if the adjacent glands are treated by some effective form of radiation. But when the patient comes late, it is probably the most hopeless form of carcinoma and the one for which we can do the least.

Leukoplakia is usually a forerunner of epithelioma and responds more readily to radium than to any other method I have tried or seen. I have one case of tuberculosis of the palate under treatment that responded to radium promptly. The X-ray, on account of its inaccessibility, would not have been effective. I treated the external glands with X-ray, a procedure which I have adopted since I have been using mesothorium in diseases of the mouth and the throat. This is just as important as the removal of the glands and raying after operation for carcinoma of the breast.

Carcinoma of the breast is one of the most common forms seen by the radio-therapeutist, and one over which there has been more discussion, for and against, than any other form of cancer treated. When patients of carcinoma of the breast are told the truth (so too much is not expected), I believe that this is the most grateful class of patients we have treated by radio-therapy, because so much can be done and in the hopeless cases so much relief is afforded.

Pinch's report of the radium institute shows that 128 cases of mammary carcinoma applied for treatment in 1913, which far exceeded that of any other malignant condition. His policy is still rigidly adhered to in declining to treat operable cases just the same as the Roentgenologist. In speaking of carcinoma of the breast he states that, "many patients exhibit a great susceptibility to radium; the primary growth becomes smaller, infected glands and subcutaneous nodules lessened or perhaps even disappeared and that little or no effect appears to be exerted in prevention of metastatic deposits, though the treatment has not, at any rate, hastened their dissemination." This is one place I believe where the Roentgen rays are superior to radium, and I am sure that the X-ray does check metastases while Pinch in the above quotation claims radium

does not. Even if radium had a greater therapeutic effect than the X-ray, the latter is preferred in any form of carcinoma of the breast on account of the great mass of rays that can be poured into the body, giving large doses to more distant parts. In the future, this statement may have to be modified, providing radium is available in sufficient quantities. On account of the lymphatic supply being so great and so widely distributed, it is necessary to radiate the whole chest and mediastinum with high penetrating rays, using the cross fire method; that is, applying the rays from the front, back and side at different angles.

Radium or mesothorium is a very useful and at times necessary adjunct to Roentgen therapy, in treating carcinoma of the breast, as a radium tube can be placed in the axilla, where X-ray is difficult or impossible to apply in many cases, particularly after operation. During the past eight months I have adopted this method whenever possible and, without going into detail, it acted like a massive dose of the Roentgen rays. In some cases I have applied a tube of mesothorium over the supra clavicular glands because it is often difficult to keep a nervous patient still in the proper position while giving Roentgen therapy. This was before I had been using the Coolidge tube.

The treatment of fibroid of the uterus and cancer of the uterus and rectum by radium and the Roentgen ray is a large and very important subject, and my experience is so limited compared to some of our members' and to many European authorities' that I shall only mention this subject here in order that fuller discussion may follow. Every one here is familiar, at least to a certain extent, with the work done in the clinics of Koenig and Gauss, Albert Schoenberg, Bumm, Doderlein and others. The symposium of Pfahler and Kelly at the last meeting of the American Medical Association in Atlantic City will do much toward enlightening not only the general medical profession, but many of the Roentgenologists who have neglected this very important subject.

In the treatment of fibroid of the uterus, I have used Roentgen rays alone up to the present time, while in carcinoma of the uterus, as a prophylactic measure, and in inoperable carcinoma of the rectum, I have been using mesothorium locally and the Roentgen rays by the cross-fire method externally. The general opinion of rectal carcinoma is that the disease displays great variation to ray therapy; often a proctitis occurs, which is usually transient, but sometimes persists and adds greatly to the discomfort of the patient. In one case in which this occurred, the symptoms were relieved by a suppository containing five grains of iodoform. It has been noted that when the growths are situated low down there is always more tenesmus than when in the upper half of the rectum. In some instances before inserting the tube, I have found it necessary to give the patient an injection of morphine. I have a case now where the surgeon intends to make an artificial anus so that the irritation of the feces will be avoided. He feels sure that then much better results can be obtained. Temporary results have been marked; that is, pain has been relieved and the mass has been reduced. Two cases that improved, in which the distressing symptoms disappeared and the mass became smaller and more freely movable, were operated upon. One is in good condition and expects to continue the treatment, the other case developed a rectal abscess and was unable to return for treatment.

The results in inoperable and recurrent carcinoma of the uterus have been gratifying, in that the local manifestation of the disease has been benefited in a striking manner. Checking of hemorrhage and discharge, relief from pain and the healing of ulceration with a reduction in the size of the mass in a large percentage of cases have been observed. In some patients the relief of these symptoms is only temporary, while many authorities have shown, by using radium locally and X-ray externally, a certain percentage of apparent cures have been obtained. I treated a case four months ago where there was a recurrence after hysterec-

tomy. Upon examination three weeks ago no evidence of the disease could be found. We expect to give more treatment. The results which have been accomplished in deep seated malignant growths have been the means of inducing a few surgeons to refer patients for radiation after hysterectomy.

In conclusion, it should be stated that there is some confusion in the minds of many in regard to the limitations of radium and Roentgen therapy. It is generally conceded that certain lesions can be just as well treated with one agent as with the other. Many authorities conclude that the only places where radium is superior to the Roentgen rays is in its accessibility in cavities and in its greater penetrating power. Most lesions are so situated that rays so penetrating as those of the high gamma rays are not necessary for the best possible therapeutic results. We know that the high X-rays give, in a majority of cases, results quite as good as those obtained from radium.

The reason why the X-ray has maintained its place in the treatment of cancer is not merely on account of the difficulty of obtaining sufficient radium; but it has the advantage of being administered in a fairly uniform dose over considerable area and depth, whereas, the radiation from radium is only effective within comparatively short distances. Thus, in carcinoma of the mouth, esophagus, rectum, cervix, etc., radium should be preferred for the treatment of the primary growth, although X-ray is necessary in the treatment of the lymphatics draining the part. In other words it is impossible to treat large areas homogenously by radium.

If radio-therapy was employed only as a prophylactic routine measure, many lives would be lengthened and many recurrences prevented. Rapidity of development of the growth is no contra-indication to ray treatment, although the dissemination of the disease is more rapid and even when the local growth disappears recurrence in distant parts is more common. At the stage at which malignant growths are referred for radio-therapy it is true that only a small proportion of the cases get well but no other method even offers any hope of relief. Experience of a number of years has taught Roentgenologists to look for temporary improvement in the treatment of malignancy as a matter of course. For instance, anything from one to three years' prolongation of life is the usual and is almost the rule in hopeless and recurrent cases. We are accustomed to see recurrent growths disappear in a few weeks, with complete restoration of health. When such results are produced by radium they are looked upon as marvelous, chiefly because they are now seen for the first time by physicians who had no previous belief in the efficiency of ray therapy in any form, but now progress is coming about by co-operation of the surgeon and the professional radio-therapeutist, when the proper ray is selected for each case.

Finally, radium therapy is the method of choice in carcinoma of the rectum, vagina, uterus, axilla, etc., but even here the X-ray forms a useful adjunct so far as the adjacent parts are concerned. The rays from both radium and the X-ray affect certain cells more than others, lymphoid tissue and the endothelium of the blood vessels being first affected. All cells that are undergoing rapid reproduction are more readily affected than where the reproduction is normal. Tumors rich in blood vessels and spreading by the lymphatics are checked in three ways: first, by the action on the epithelial cells, second, the endothelium of the blood vessels undergoes proliferation until the lumen is almost obliterated, and third, the channels or lymphatic glands are blocked, preventing metastases.

A PORTABLE VIEWING BOX

By JOHN McWILLIAMS BERRY, M. D., Roentgenologist Albany Hospital, Albany, N. Y.

Fig. 1

Every roentgenologist who has demonstrated roentgenograms at a medical meeting or in a court room has felt the need of a portable viewing box. The usual viewing boxes, on account of their shape, size and weight, are difficult to transport; there is great danger of their being broken in transit; and they are awkward things to move around when it is desired to demonstrate plates in various parts of a room. The latter objection applies especially in court room work, since it is almost impossible to place an ordinary viewing box where everyone interested can see the plates and the box is far too bulky to pass around.

The accompanying photographs illustrate a portable viewing box that, in large measure, overcomes the above mentioned objections.

Fig. 1 shows the viewing box ready for transportation. It can be carried like a suit case.

The front of the box consists of an ordinary 14/17 photographic printing frame holding a sheet of opal glass. The spring back of the printing frame serves to protect the opal glass when the box is in transit. Brass handles are fastened to the sides of the frame. These serve for carrying and also for holding the viewing box when passing it from one observer to another. In a court room, for example, the box can easily be passed from one juryman to another.

A tin tray, either end of which is formed by an Edison, tubular, 40 watt, mazda lamp in a "show case" reflector, is fastened to, what would be, the front of the printing frame. The tray is painted white on the inside and, with the tungsten lamps and opal glass front, makes a very satisfactory viewing box.

Fig. 2 shows the box opened. One lamp

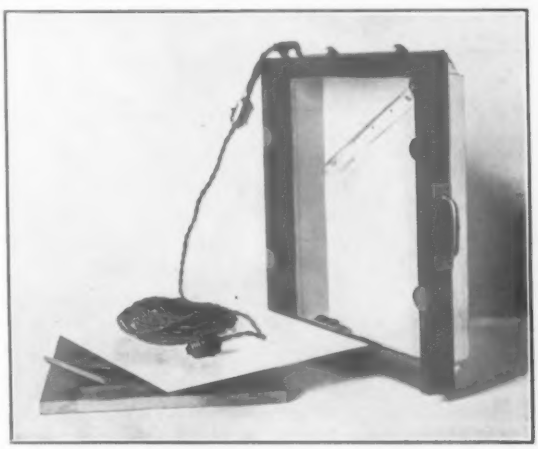


Fig. 2

has been swung out from its holder and the long connecting cord, with a "feed-through" switch attached, is shown coiled up on the opal glass. When the box is closed and ready for transportation the connecting cord is coiled up inside. If only one or two plates are to be demonstrated they can also be carried in the box, being held in place and protected by the spring back of the printing frame.

CHARACTERISTIC ROENTGEN FINDINGS OF DUODENAL ULCER

By DR. PAUL EISEN

Certain Roentgen findings are now considered significant, others a direct proof of the presence of duodenal ulcer. But at times even in the presence of characteristic Roentgen findings, no ulcer is found at operation. Besides not every case diagnosed as duodenal ulcer is operated upon. At best, we must admit that the Roentgen method is still in its development. From what is actually positive in the Roentgenogram, too far-fetched conclusions are frequently drawn.

It is essential that the Roentgenologist cooperate with the surgeon and they together examine the case, so that each will contribute his knowledge of Roentgenological as well as clinical findings, and thus reach a diagnosis. From Roentgenograms and fluoroscopic findings alone one should not make a diagnosis. At the North Chicago Hospital, I have the advantage of conducting both the clinical and Roentgenological examination. I follow each case to the operating table of one surgeon (Dr. Carl Beck). The case is again examined on leaving the hospital. In this way I can check up my findings.

I shall endeavor to point out the most characteristic signs indicating the presence of a duodenal ulcer. It is said that a niche which is characteristic in ulcer of the lesser curvature of the stomach is also found in ulcer of the duodenum. Such niche may rarely be present. But can we say that it occurs with such regularity as to consider it characteristic of duodenal ulcer? Haudek and Carman found it only twice, George about six times. If men who examine hundreds of cases for duodenal ulcer find it so rarely as this, then it certainly cannot be considered a usual occurrence and a diagnostic sign of ulcer. There is to me a plausible explanation why this niche should not occur with the same regularity in the duodenum as it does at the small curvature of the stomach, namely, there is no crater in the majority of duodenal ulcers. And again another reason is that in the stomach which is closed at both ends pressure will bring out the niche, while attempts to fill out the entire duodenum have as yet not been entirely successful. Besides, George, Cole, Strauss and others have found a sacculation due to adhesions simulating this niche. True duodenal diverticula would also produce a niche. Even if they are comparatively rare, the presence of a niche might indicate a diverticulum and not an ulcer. Therefore, I would not assert that a niche in the duodenum signifies ulcer.

Cole and George consider a certain outline of the duodenum as normal, the contents filling the lumen. Certain deviations from this contour they interpret as deformities due to ulcer, if seen constantly, one normal contour ruling out ulcer. A retraction is described as occurring opposite an ulcer, the lesion itself also being marked as an irregularity in contour.

I believe Forssell has proven definitely that the retractions, the so-called hour-glass "spasm or incisura," in ulcer of the stomach are due to segmentation. These elevate the contents above the ulcer's level and prevent traction on the lesion. That segmentation is a normal function of the duodenum has been shown in animals by Cannon. May this not simulate the above-named retraction in duodenal ulcer? In the two cases of Schlesinger and Munk no operation was performed. Cases of Cole and George were found to have had ulcer. May we accept their interpretation? And, if so, what is really characteristic of this retraction? Is it also stationary? Is its function also that of setting the ulcer at rest? In other tubular parts of the digestive tract Stierlin has

taught us that the opposite supervenes. Likewise, in all my cases of acute appendicitis I was unable to fill the appendiceal lumen. Is the duodenum an exception? Personally, I would hesitate to make a diagnosis from an irregularity in contour, unless I knew that I had well filled out the whole duodenum.

In the third place, considering the foregoing, what stress should we lay upon duodenal retention? Is the so-called persistent filling of the bulbus duodeni of any characteristic significance, just because it has been found in cases of duodenal ulcer? I here exclude adhesions. From what I infer in studying the cases of Bier and Kuemmel, many were old chronic cases, so-called "ptosis," in reality relaxation, the sinus ventriculi very low in relation to the pylorus, but the pylorus also normally to the left and down.

This low pylorus in itself makes the duodenal residue in the upright posture explicable, especially if the pars superior duodeni rises high up. That retention like this favors ulcer with a sour medium, there is no doubt. But does it signify ulcer? Carman lays little stress on this sign of "lagging." I believe anatomical relations other than ulcer readily explain it.

In the fourth place, the coincidence of parts of the duodenum with a point of tenderness would probably be of more value, if we could palpate the duodenum and its attachments with the same ease as we can the appendix region. Here the sign of tenderness has proven of value to me in many cases; not in all.

With the duodenum out of reach, I would pay still less attention to tenderness. Carman does not attach as much importance to this sign as does Haudek. Traction on the duodenum may cause pain in this region under normal conditions. Sufficient pressure is anything but comfortable normally. Where we have other more reliable signs, we might dispense with this one.

In the fifth place, there remain two duodenal findings that are inseparable Roentgenologically, stenosis and fixation of the duodenum. In stenosis Bier and Schlesinger have demonstrated the existence of an abrupt narrowing of the lumen, in fixation Cole has found the lumen constricted, the cap asymmetrical, displaced or absent, the pyloric sphincter widened, to mention only a few of his findings. That this is often due to other lesions than duodenal ulcer Cole readily admits. In fact, I have found no one who states that these changes are characteristic of duodenal ulcer, only that they are present.

Conditions often found at operation have frequently escaped consideration in the interpretation of the Roentgen findings. The character, extent or limitation of a lesion can not be established Roentgenologically. The findings admit a topographical diagnosis, not a clinical one. Nevertheless, there is little dispute regarding their value. The main argument that I would like to bring forth in this connection is that they demonstrate an anatomical obstruction in the duodenum of the severest degree. For obvious reasons, the stomach is only slightly enlarged. Ulcer of the duodenum must always come into consideration, where the two signs (stenosis and fixation) are present, no matter if the clinical evidence points to ulcer or not. From the foregoing, one can conclude that there are duodenal ulcers that cause duodenal obstruction which is demonstrable. But in the other cases of duodenal ulcer is there no evidence of obstruction? In this connection we must consider the stomach.

According to the earlier publications on the characteristic Roentgen findings of duodenal ulcer, since Barclay first described them, we most often meet the assertion that the rays showed us a stomach which emptied very rapidly. This was explained as due to the action of the pylorus and the over-activity of the stomach. Subsequently a later examination of the same cases showed considerable retention six hours after the meal. This has led to such confusion that some attach no value whatever to the Roentgenological stomach findings in duodenal ulcer. I will try to show that not only are the stomach findings indispensable among

the Roentgen signs in duodenal ulcer, but that they often, if not always, point to one and the same anatomical factor, an obstruction at the pylorus. If the obstruction is permanent or only intermittent, remains to be proven. Surgeons will recognize an obstruction after their attention has once been called to it.

To me the most significant sign of obstruction, is the fixation of the pyloric sphincter. However, no significance was attributed to this fixation. Not until Forssell's studies was its nature revealed. Even Schlesinger tries to explain it on the basis of increased peristaltic action. According to Forssell, the pylorus in the prone position lies naturally to the right. When the body is erect, the pylorus moves over to the left, and with the descent of the diaphragm, moves downward.

In the lesions involving the pars superior duodeni, especially ulcer, the tonic contraction of the whole transverse stomach holds the pylorus in place. It is the stomach therefore, that actively immobilizes the adjacent mobile part of the duodenum, and in this way counteracts painful traction on the lesion. This tonic contraction is what was formerly called "hypertony." It is the systole of Cole. The plates of Johannes Mueller in the "Fortschritte" show well the position of the pylorus in duodenal ulcer.

Another sign of duodenal ulcer is likewise little understood and is constantly misinterpreted. I mean the sign that Carman calls "hyperperistalsis." In the stomach one must consider more than the stages of relaxation and contraction. It is more important to separate, during contraction, the activity of the vertical from that of the transverse stomach, as Forssell has outlined. Then everything is more clear. In a vertical stomach we see segmentation, in the transverse stomach katastalsis, both of an intensified character. The retractions of segmentation are stationary, the katastaltic ring of contraction alone moves toward but not quite up to the pylorus; a concentric contraction of the terminal portion of the canal completes the process. Cole's serial plates show this plainly. In duodenal ulcer the progress of the ring of contraction is often remarkably slow. With ingestion of food, rapid progression is more often seen. The incisura angularis is likewise mistaken for a peristaltic retraction. Hyperperistalsis is seen in cases other than ulcer. Carman mentions six gall bladder cases. In cases of appendicitis I have also observed it, but in a less degree. In one case of duodenal ulcer with relaxed stomach only sluggish terminal katastalsis was to be seen. An old indurated duodenal ulcer was found. What causes this remarkable symptom of hyperperistalsis? In its severest form it is found in pyloric stenosis.

In a relaxed stomach associated with duodenal ulcer manual manipulation or pressure on the abdomen can incite "hyperperistalsis." Obstruction must be present. Is there obstruction at the pylorus in all cases of duodenal ulcer? Must we resort to Schlesinger's theory of a primary functional irritability of the stomach, of a reflex neurosis excited by the duodenal lesion? I believe not.

As one factor of obstruction I have mentioned pyloric fixation. It is a well-known fact that in duodenal ulcer we have "pylorospasm." But we can't demonstrate it Roentgenologically. At least, I can't. It certainly ought to cause obstruction. Lately I have tried papaverin upon Holzknecht's recommendation to determine the presence or absence of obstruction. At present it is too early to draw definite conclusions. Effleurage will drive contents through the pylorus as Haudek has shown. Plates taken by Cole during hyperperistaltic action show a pyloric lumen. Maybe Schlesinger has led us on the right track. He explains this gaping pylorus as due to contraction of both its circular and longitudinal fibres which latter dip into the pyloric diaphragm. Possibly the sharp angle of the canal with the descending part of the duodenum also constitutes the obstruction.

That there is an obstruction at the pylorus, even if only intermittent, is directly proven by the permanent expansion of the evacuating channel of the stomach. This is

a structural change in the musculature of the stomach.

All pictures of duodenal ulcer taken during contraction of the transverse stomach show this so-called protrusion to the right. Relaxed stomachs naturally fail to show it. In experiments on dogs I have found the same condition present. This slight degree of enlargement of the stomach is often overlooked by the surgeon. Even in cases of severest duodenal stenosis, the enlargement is not considerable. This alone differentiates it from pyloric stenosis of long standing.

If we hadn't these direct signs to prove a temporary pyloric obstruction in cases of duodenal ulcer, the residue seen after six hours is the mute evidence of resistance to expulsion in active stomachs. It is seen in many cases. Such gastric retention is seen especially in relaxed stomachs whose forces of expulsion have become diminished. Why is gastric retention missing in so many cases, even in the majority? My only explanation is that here the compensatory overactivity of the stomach has overcome the resistance. Hypertrophy of the musculature would best prove this. Have such examinations of human stomachs with duodenal ulcer been made, for instance, in perforation? Signs may exist by which we will later differentiate between acute and chronic ulcer. In acute appendicitis I mentioned the fact that the lumen will often be invisible. I hope further study will help us differentiate likewise between acute and chronic duodenal ulcer.

My contention, that duodenal ulcer causes obstruction at the pylorus and that the Roentgen findings of the stomach are to be interpreted in this sense, is not new. Haudek holds a similar view when he states that he cannot differentiate pre-pyloric from post-pyloric ulcer and appears content with stating the presence of peripyloric involvement. Kelling admits the same. If to the stomach findings we can add characteristic Roentgen findings in the duodenum they will help to confirm the clinical diagnosis. But, in our enthusiasm over the presence of duodenal Roentgen findings, we must not neglect those of the stomach in duodenal ulcer, for these should lead to a careful examination of the duodenum.

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EDITORIAL

Dr. George C. Johnston of the Executive Committee transmitted to us a letter from Mr. Clyde Snook in which it is made evident that the American Roentgen Manufacturers' Association has not been successful in taking care of the manufacturers' exhibit for the coming Atlantic City meeting. We regret that this organization has not had smooth sailing but we are very glad to announce officially that there *will* be a manufacturers' exhibit at the Hotel Chalfonte. There is every prospect that the individual exhibits will be most interesting and there will be shown new and standard apparatus by practically all of the prominent American manufacturers. We, however, trust that the Manufacturers' Association will be able to satisfactorily perfect its organization so that another year it will assume full charge of this important feature of the annual meeting.

Owing to the increasing demand on the part of the surgeons and also on the part of the laity for repeated observations of fractures in their course of treatment and healing, it would be very beneficial if some far-seeing manufacturer would devise and place upon the market a transportable Roentgen apparatus for use in hospitals. It is surely a reflection upon our methods of handling patients and a reflection on hospital efficiency to remove an extension from a patient with a fracture of the femur, place him on a stretcher, transport him to the X-ray laboratory and Roentgenograph his broken leg with the extension removed. If there could be injected into hospital management some of the efficiency which is now common in modern factories, it would simplify the handling of the injured and certainly prevent much needless suffering.

ABSTRACTS

Berkman, David M., M. D., Rochester, Minn. (Mayo Clinic): Accidental Roentgen Diagnosis of Cholelithiasis. (Interstate Medical Journal, June, 1915, vol. xxii, No. 6, p. 615.)

The experience of the Mayo clinic has been that in the diagnosis of gall-stones by the Roentgen ray a negative finding is worthless, while a positive finding is most conclusive evidence. A striking illustration is offered by the following case in which the diagnosis was accidentally made during the course of routine Roentgen examination of the dorsal and lumbar vertebrae.

CASE 123,430. Man, aged thirty-seven. Previous history negative. Clinical history: Fifteen years ago patient had an attack of very severe cramping pain in the epigastrium lasting half an hour. Since then he has occasionally had slight distress in the right side, to which he attached no significance. His present trouble began five years ago with an attack of lumbago, and since then he has had backache almost continuously, located at the lumbosacral juncture, with a few tender areas higher up. This condition has kept him very nervous. He is under weight and incapable of doing as much work as formerly; has been forced to give up part of his practice. Bowels regular; appetite good. Physical examination negative. Roentgen findings: Pendulous gall-bladder, full of stones, hanging down toward the right pelvis. Spine negative. Operation: Cholecystectomy and appendectomy. Gall-bladder was found filled with stones. The appendix showed well-marked evidence of disease.

Since the operation, one month ago, the patient has been absolutely free from backache for the first time since the trouble began. His general condition has improved proportionately.

Lange, Sidney, A. B., M. D., Cincinnati, Ohio: Epithelioma of the Lip Cured by Single Roentgen Ray Treatment. (The Lancet-Clinic, April 24, 1915, vol. cxiii, No. 17, p. 461.)

Lange cites the case of a man, aged sixty-four, who had noticed a sore spot on the right side of his lower lip for two years. The patient claimed that the trouble started from a fall on the lip. He consulted several physicians, all of whom diagnosed the lesion to be a cancer and recommended surgical removal. He had also been given full doses of potassium iodide. In November, 1914, the lesion involved almost two-thirds of the lower lip. As the surgical removal would involve practically the loss of the entire lower lip, he was referred to Lange with a view to using the Roentgen ray. Lange began Roentgen ray treatment November 13th. One full dose, using the Coolidge tube, was given. This required five minutes' time. On the same date three prophylactic deep doses were given under the chin and on each side of the neck to sclerose the cervical lymphatics. Two weeks later he gave another deep dose to the glands of the neck, but did not expose the lip. There was a marked reaction in the lip at this time. On December 5th the reaction in the lower lip had not yet abated. Lange gave another prophylactic treatment to the glands of the neck. He did not see the patient again until three months after the last treatment. The lesion was then entirely healed. In the neck there was to be felt a small gland on the left side, that is, on the side opposite to the side of the previous lesion. This gland was felt at the time Lange began the treatments. The patient insisted that that gland had been palpable in his neck since he had the mumps many years ago. This gland did not change any during the course of the treatment.

Young, Edward L., Jr., M. D., Boston, Mass.: A New Preparation for Pyelography. (Boston Med. and Surg. Jour., April 15, 1915, vol. clxxii, No. 15, p. 539.)

The following is the formula of the substance prepared by Godsoe, the pharmacist at the Massachusetts General Hospital, and used by Young: Quince seed, 100 grains; water, 8 ounces. Macerate for twenty-four hours with frequent agitation. Do not crush the seed. Strain through cloth. Add two per cent. boric acid up to twenty ounces. It

is important to extract with water and not with the boric acid solution, as boric acid solution does not make a good mucilage. Enough of this mucilage is added to 12½ c. c. of argentide to make 50 c. c., and vigorously shaken for two minutes. Again, the shaking is an essential part of the process. The resulting emulsion lasts several weeks, and is a thin, clear fluid flowing readily through a ureter catheter. It is on the method of preparation and the character of the resulting emulsion that the value of this substance depends.

They have used this emulsion on the genito-urinary service at the Massachusetts General Hospital for about three months, with uniformly good results as regards pictures, far better than with collargol. There have been no cases with anything more than the temporary reaction caused by the cystoscopy and the filling of the renal pelvis, and no untoward after-results. They have taken roentgenograms one, two and three days afterward in several cases. In two, both pathological pelves, there was a marked residue the next day. In one this was, however, gone the second day. The other showed small shadows five days later. The kidney was removed the sixth day following injection. On section there were very fine specks of argentide in a few spots near the flattened papillae, not adherent to mucous membrane. The pyonephrotic cavity was remarkably clean, considering the previous pus from that side. Microscopically, there was no evidence of absorption. In two other cases there was a very slight doubtful residue the day after the Roentgen ray. In three cases the kidney was operated on, one in twenty-four hours, and one in forty-eight hours, and one in six days. The first one was exposed, the upper part of the ureter and pelvis carefully examined, and finally opened. There was no evidence of irritation and none of the emulsion seen. This was a case of double pelvis and ureter with bleeding from the upper pelvis. The upper pelvis was injected, the lower one was not. At operation absolutely no difference could be seen in the appearance. The second case was a pyonephrosis, where the kidney was removed. Three c. c. of the emulsion was injected. The picture showed the destroyed character of the kidney very well. There was no macroscopic or microscopic evidence of the argentide anywhere in or around the pelvis or kidney. This kidney was estimated to have held at least 25 c. c., so that the shadows were thrown by about ½ to 1 per cent. strength. The third was a pyonephrosis, and a shadow was thrown by 3 c. c. of emulsion. The cavity held about 15 or 20 c. c.

Young calls attention to three points of technic only. He uses the barrel of a 10 c. c. syringe as the container, from which the emulsion flows into the pelvis. When the pictures are taken, this is disconnected from the catheter, emptied, the piston inserted and as much of the emulsion as possible sucked out of the kidney pelvis. In the majority of cases the larger part can be recovered. The pelvis is then washed out once or twice with boric acid or salt solution. In all of the work with these cases, small amounts, in no case over 3 c. c., have given us good shadows.

Young concludes as follows: Collargol is an absorbable kidney poison when used in the renal pelvis.

The emulsion of argentide is a clean, non-absorbable, opaque fluid, which can be used with the minimum danger to the patient and maximum satisfaction to the surgeon.

Bowen, David R., M. D., Philadelphia, Pa.: Epiphyseal Separation-Fracture. (Interstate Medical Journal, June, 1915, vol. xxii, No. 6, p. 607.)

Bowen has collected 38 cases in the Roentgen service of the Pennsylvania Hospital. Of these, 21 were of the distal end of the radius: 1 at 7 years, 2 at 9, 6 at 10, 1 at 11, 3 at 13, 3 at 14, 3 at 15, 1 at 16, 1 at 18.

Four cases were of the head of the radius: 3 at 12, 1 at 13.

Four cases of the metacarpal: 2 at 10, 1 at 13, 1 at 14.

Two cases of the distal end of the humerus: 1 at 5, 1 at 12.

Two cases of the distal end of the femur: 1 at 14, 1 at 22.

One case of the fibula, about 15 years.

Four cases of the base of the tibia: 2 at 8, 2 at 16.

During the same period he has seen no case of positive Roentgen diagnosis of epiphyseal separation without this fracture. For this reason he proposes the term epiphyseal separation-fracture as one fitted to describe this condition, and to emphasize its frequency.

Giffin, H. Z., M. D., and Sheldon, W. D., M. D., Rochester, Minn. (Mayo Clinic): Clinical and Roentgenologic Findings in Pulmonary Tuberculosis. (The Journal-Lancet, May 1, 1915, vol. xxxv, p. 223.)

The relative value of the study of stereoscopic plates of the chest as an aid in the diagnosis of pulmonary tuberculosis will naturally vary with many factors. The skill with which the Roentgen plates are made, the conservatism and the experience of their interpreter, on the one hand; and the skill of the internist, the degree of care in searching for physical signs, and the length of time during which a patient may be under observation, on the other, will cause a great variation in the esteem for roentgenology in different clinics. While a highly presumptive diagnosis of pulmonary tuberculosis may be based upon definite signs alone, nevertheless the only absolute proof of a positive diagnosis is the finding of the tubercle bacillus in the sputum. In a series of 373 patients with tuberculosis of the lungs, observed in the Mayo clinic, between July, 1913, and June, 1914, 194 showed positive sputum. Of the 194, 177 were radiographed. In these 177 cases with positive sputum that were radiographed, an *independent* X-ray diagnosis was given. This diagnosis was based on a study of stereoscopic plates. In every instance save one the X-ray diagnosis was positive for tuberculosis. We can therefore assert with some degree of finality that practically every case of pulmonary tuberculosis in which tubercle bacilli are found in the sputum will show positive findings on a proper radiographic study.

Recent cases have been used in this study to profit by the increased experience and skill of the roentgenologist, and the keener interest and more careful work on the part of the clinician which has naturally resulted from the several previous years of attention.

Of the 373 cases, there were 142 positive X-ray diagnoses in which the sputum, if any, was negative. In these instances the diagnosis by clinician methods is, of course, not conclusive because of the fact that healed tuberculosis and early tuberculosis and lesions centrally located may give no signs, while diffuse and miliary tuberculosis may produce very indefinite findings. A review of the histories, however, almost always corroborated the Roentgen findings.

The one case mentioned above in which the sputum contained tubercle bacilli and in which the X-ray findings were negative, is worthy of discussion. This patient was a girl, aged 24 years, who gave a three-year history of complaint. Long periods had been spent in bed; cough and fever had been present at times. She had raised several mouthfuls of blood. For three years the pulse-rate had been rapid, the rate frequently reaching 120. An enlargement of the thyroid had been noticed for two years, together with weakness, nervousness, tremor, and dyspnea. Tubercle bacilli had formerly been found in the sputum. Recently there had been a gradual gain in weight up to 195 pounds. Absolutely no signs were noted on examination of the chest, while the X-ray plates showed only bronchial thickening. It may be possible that this case was not one of pulmonary tuberculosis, but rather of hilus tuberculosis. The possibility of a tuberculosis bronchitis must also be considered.

It was formerly believed and stated that radiography would never reveal a lesion that could not be found by the internist, provided a reasonably thorough and prolonged observation of the patient were made. This, the authors believe, has been disproved. They have studied their cases with respect to the physical signs, the clinical history, and the probability of a diagnosis without the X-ray

findings, each of these on a basis of 4—4 representing a diagnosis made positive by the finding of the tubercle bacillus. Of 154 cases in which tubercle bacilli were not found, there were 30 in which the probability of a diagnosis upon clinical findings alone was extremely small (degree 1), and 20 in which a diagnosis seemed entirely impossible. This latter group of 20, in which a diagnosis was impossible, included early cases, healed cases, and diffuse tuberculosis.

Another question naturally arises: Will the roentgenologist make a diagnosis in early lesions? It must be emphasized that the diagnosis depends on the interpretation of the plate. The roentgenologist, not the X-ray, makes a diagnosis. There has been a constant inclination to fall into the error of ascribing a few signs at the apex of the lung to tuberculosis, especially in the individual who is neurasthenic or debilitated. But these findings are only presumptive evidence of tuberculosis. Apical signs without tuberculosis occur most frequently in children; and occasionally in an adult a localized apical bronchitis is quite apt to occur, especially in association with nasal affections. These patients will naturally improve on fresh air and constitutional treatment, and may be classfied falsely as "cured" cases of tuberculosis. One hundred and ninety-four cases of the series gave positive sputum. Of these, 177 were X-rayed and no case that could be classified as an early tuberculosis was found in which the X-ray report was negative. The one patient cited above in whom tubercle bacilli were present and the stereoscopic plates were negative, cannot be grouped with the early cases, for the duration of the history was three years. Of the above series, 24 are regarded as so-called early cases from a consideration of the history and findings.

An occasional case suggests a probable diagnosis of tuberculosis when the sputum and X-ray are negative. Two cases of this type are included in the series. In one of these, a girl of 14, there had been cough for six months, but no sputum. Two hemorrhages, however, had occurred in the last two months. The physical signs were so indefinite as to be practically negative. In the other case, a woman of 27, there was a history of pleurisy seven years previously, and this was followed by cough, sputum, and night-sweats. The patient came to a physician because of gastric symptoms, slight cough, and expectoration. A few fine crackles were heard over both apices, while the breath-sounds were harsh over the left upper lobe. Examination by X-ray, however, was negative.

The most interesting assistance obtained consists of the visualization of suspicions as they are revealed by the radiogram. The development of a keener sense of perception has followed the corroboration of findings when shown graphically on the plate. Many failures in diagnosis have occurred, and roentgenology has really been a stimulus to physicians to perfect their skill in physical diagnosis that they might not lose their proper place in the scheme for co-operative laboratory and clinical conclusions.

The Roentgen ray in almost every instance shows a more extensive lesion than was suspected by physical examination. It may therefore be of considerable value from a prognostic standpoint. It also frequently shows lesions which, on account of their location, are to all other methods inaccessible.

In the routine of general diagnosis, a negative radiologic report of the lungs may be of very great value. Further experience may show that the negative value is equally as great as, if not greater than, that obtained in a positive way.

The authors summarize their paper as follows:

A careful study of 373 cases showed that practically every case of pulmonary tuberculosis with tubercle bacilli in the sputum can be diagnosed independently by the roentgenologist. In almost all of those cases in which a roentgenologic diagnosis was positive when the sputum was negative, a review of the histories has corroborated the Roentgen findings. In a considerable number of patients a diagnosis seems entirely impossible by clinical methods although the roentgenolo-

gist reports positive findings. These include so-called early cases, healed cases, and diffuse tuberculosis. It would seem that a careful study of stereoscopic plates of the chest will show evidences of tuberculosis as early as we can at present be positive of its existence by any other method. A keener sense of perception is developed through the visualization of lesions, and that roentgenology has been a stimulus to physicians in perfecting their skill in physical diagnosis. The information obtained from the negative report of a skillful roentgenologist may be of very great assistance in general medical and surgical diagnosis. Finally, the authors emphasize that trustworthy conclusions can be drawn only by one who has had a considerable experience in the reading of stereoscopic plates. The roentgenologist, not the radiogram, makes the diagnosis.